NATURE

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The Progress of Science in India

IT is one hundred and three years since Macaulay wrote his famous minute on education in India, in which he stated that it was impossible, with the limited means available, to attempt to educate the body of the people. This century has seen an amazing development in all directions. Politically, self-government has been largely achieved and this has been rendered possible by the adoption, as advocated by Macaulay, of English as the medium of education. English has become the *lingua franca* of the Peninsula, and the mass of the discussions in the legislative councils is conducted in that language. But there has occurred another, if less dramatic, change. An educational ladder has been provided which has opened a clear road from the village primary school to the university. In the space of a century, India has passed from a social state with an aristocracy as strongly marked as in the Norman period, with a priestly hierarchy as dominant as in the palmy days of the monasteries and with the mass of the people in a state of serfdom equally reminiscent of those early English days, to a state with all the democratic institutions of modern England and with an industrial development of no mean proportion if, as yet, small when judged by the percentage of population so engaged.

In this movement science, both pure and in its application, has received its full share of attention. Science, in its modern sense, found its first footing in India in 1784 with the foundation by Sir William Jones of the Asiatick Society, now known as the Royal Asiatic Society of Bengal, and that footing was extended and fortified by other societies of which the best known is the Bombay Natural History Society founded in 1883. These were unofficial ventures. Officialdom took longer to recognize the status of science. In those early days, certain services clearly lay beyond the capacity of the civil administration as established by the East India Company. For these, special services had to be instituted; a medical service, first established as distinct from the Army medical service in 1763, and a trigonometrical survey in 1800, which were staffed from the only technical source available, namely, the Army.

With a growing recognition of the need for specialized knowledge in other fields, it was only natural that the civil authorities should turn to the same source to find the cadre. Thus, to mention one sphere only, botanical work was entrusted to men of the medical services who, as such names as Roxburgh, Royle, Wallich, Prain and Watt testify, laid a solid foundation for later building; while, to mention the other service as well as to sound a personal note, an Army engineer, an uncle of the present writer, became controller of the mint.

But science was moving fast, particularly in its application to the everyday facts of life. It was also becoming more specialized, and something more than diversion of the talent existing in these established services was required. India is an agricultural country still, and was even more so at the end of the last century, when great strides were being made in the application of science to agriculture in temperate countries. To Sir Edward Buck falls the credit of realizing the need for investigating the fundamental problems of Indian agriculture and the special nature of these problems. Thus came to be employed a group of specialists—Leather, Barber, Butler and Maxwell Lefroy are names that will be recalled—later, in 1903, to be incorporated into one service, the Indian Agricultural Service, with its imperial branch at Pusa and a provincial branch in each province.

Two motives can be traced in the above-noted developments. The first of these is that general thirst for knowledge which, at first finding outlet in private directions, afterwards became translated into official action. Thus the Botanic Gardens of Calcutta, founded in 1788, became the centre of the Botanical Survey of India in 1889; an Archæological Department was established in 1862, while the foundation of the Indian Museum in 1866 provided a centre for this and for the study of natural history. The second was the growing economic importance of many sciences. The Geological Survey was established in 1851, the Indian Marine Survey Department in 1871, a Fisheries Department in 1870 and a centralized Meteorological Department in 1872.

In all these movements it was the British who provided the impetus. Here and there Indians played their part; Ram Mohan Roy who, so early as 1816, took a prominent part in founding a Vidyalaya afterwards to become the Hindu College and, later, the Presidency College, Calcutta, Sir Ashutosh Mookerjee, Sir Jagadis Bose and P. N. Bose. The reason for this is to be traced to the lack of facilities for, and the inadequate organization of, higher education; the potentialities of the Indian for advanced studies had not yet been appreciated. Though universities had been established at Calcutta, Bombay and Madras in 1857, at Lahore in 1882 and at Allahabad in 1887, these remained examining bodies, and teaching was relegated to the affiliated colleges, where facilities were inadequate for original work even by the staff, whose time was absorbed in teaching, and still less for postgraduate work. It remained for the Universities Commission of 1902 to transform the universities into teaching bodies with the allocation of large grants for higher education, a policy further implemented by the establishment of a separate Department of Education in 1913.

Thus, the beginning of the century marks an epoch, and the progress made since then has been remarkable. No adequate presentation could be given in a brief article; such a presentation is contained in the volume of nearly eight hundred pages* recently published. It requires no detailed turning of these pages to realize, from the names of those whose work is quoted, how quick the Indian has been to take advantage of the facilities thus newly thrown open to him. The volume has been produced to celebrate the silver jubilee of the Indian Science Congress Association, which held its first meeting under the presidency of Sir Ashutosh Mukhopadhyaya (Mookerjee) in the spring of 1914. This Association owes its origin to a realization of the growing need for some means of bringing together the increasing number of workers in the various scientific fields, and it adopted as its fundamental plan and conception the principles of the British Association.

India is a large country and the danger of isolation is greater there than in relatively small England. The need for some means of co-ordination early became apparent. The Board of Agriculture, with its annual, and later biennial, meetings served that function for the newly instituted agricultural services, though, owing to its official status and its reviews of programmes of work, it ran grave risk of adopting a dictorial attitude. Since 1929 its functions have largely devolved on the Imperial Council of Agricultural Research. In 1902 a Board of Scientific Advice was established but suspended in 1924 and, in 1911, the Indian Research Fund Association was founded mainly to co-ordinate research on the causation, mode of spread and prevention of disease.

It was to provide a field in which a co-operative spirit rooted in personal contacts rather than in co-ordination, a word which savours of officialdom and dictation, that constituted the primary objective of the Association—a field free from official dictation but having the official blessing. That it has gone a long way to achieve its purpose is undoubted, but that it has not entirely succeeded—is any human institution an unqualified success?—its foremost advocates would be the first to admit. The concept of the British Association has, perhaps, been too closely followed. This Association serves two functions; it forms a common ground on which scientific men may meet and so counteract the dangers of specialization, and it has the further objective of the dissemination of scientific thought among a wider public. That latter objective is, perhaps, the dominant one but, in India, the public which can be so influenced is small. The feeling of incompleteness, whatever its cause, is there and has found expression in the institution of supplementary societies; the Academy of Sciences, United Provinces, founded at Allahabad in 1930; the Indian Academy of Sciences founded at Bangalore in 1934 and the National Institute of Sciences of India founded at Calcutta in 1935. Scientific organization, thus, is proceeding in India centrifugally. Instead of a

* Indian Science Congress Association: Silver Jubilee, 1938. The Progress of Science in India during the past Twenty-five Years. Edited by Dr. B. Prashad. Pp. lvi+767. (Calcutta: Indian Science Congress Association, 1938.) 5 rupees.

central body arising as a coping stone, around this earlier central body are coming into existence a number of loosely linked associations each with its local sphere. This difference has significance.

India has demonstrated that it is capable of producing men with a scientific ability which would do credit to any country, but the very speed with which it has attained this position has its dangers. If, in conclusion, these are briefly indicated, it is in the spirit of the friendly criticism of one who remembers many happy years spent among its peoples. It appears to such a writer that the major danger arises from the entry of India into the scientific field at a time when the application of science to economic problems had proceeded far. It was this pressure that provided openings for a livelihood in scientific work and it was the Government that mainly created those openings. Science may easily, in these circumstances, lack the stabilizing effect of a nucleus of disinterested men studying for studies' sake, and tend to become merely a means of earning a living; and it is difficult to regard a potential competitor for a post with true scientific detachment. It is a danger from which Great Britain is not free but one which is emphasized in a country where university education is primarily sought as a qualification for employment and where pre-university education remains in many respects defective. These are, however, growing pains; with ability undoubtedly present, with the will to develop the true scientific spirit which clearly exists, who can doubt the future of science in India? H. M. L.

The Credo of an Anthropologist

Apes, Men and Morons

By Prof. Earnest Albert Hooton. Pp. ix + 307. (London: George Allen and Unwin, Ltd., 1938.) 10*s.* 6*d.* net.

IF a credo is to have value, it must be enunciated by one who has several outstanding qualifications. In the first place, it must be based on a prolonged personal experience of a particular branch of knowledge. Prof. Hooton has this qualification; he has been teaching physical anthropology to the students of Harvard University for more than a quarter of a century. In his earlier years he made a detailed report on the bones and culture of the peoples who had inhabited the Canary Islands; later he did the same for Pueblo Indians. In more recent years he has devoted himself to a physical and social study of his fellow countrymen. Of these about 6,000 had been isolated in penal institutions; his "controls" were taken from those "not yet apprehended". The full results of ten years spent in a "statistical purgatory" have not yet been published but in this book he gives in the midst of his general discourse a summary of his chief conclusions. He has found that those within the walls of penal institutions are inferior in body and in mind to those who live outside, and that already in the United States of America the population is becoming differentiated into local types.

Prof. Hooton has the knowledge, but knowledge alone is not sufficient to make a credo worth listening to. Knowledge must be linked to a sound judgment, and ultimate beliefs must be uttered with a resolution which is fearless of popular opinion. It needs as much courage to run counter to the prejudices of a democracy as to face the wrath of an autocracy. "For myself," Prof. Hooton has written, "I prefer to be the target of rotten eggs rather than to be suspected as a purveyor of that odoriferous commodity." He refuses to "side-step the issues which are vital and dangerous" and seeing that he discusses the problems of 'race', religion and sex, a less courageous man would have been tempted to "side-step" at every turn. Prof. Hooton, too, has the saving grace of humour; his pages scintillate.

A book which is made up, like the present one, of lectures and articles, is apt to be disjointed and over-lapping. There is no trace of these faults in the present work. Its pages discuss in sequence the various phases in man's ascent from the jungle. Especially is its author concerned with the impact of his science on the community. His attitude will be conveyed by an extract from his final chapter entitled: "What must we do to be Saved"?

"We must either do some biological house-cleaning or delude ourselves with the futile hope that a government of the unfit, for the unfit, and by the unfit will not perish from the earth.

"We must, in some way or other, encourage a sit-down reproductive strike of the busy breeders among the morons, criminals and social ineffectuals of our population. . . . We must inculcate into the rising generation a code of biological ethics. . . . The emergency demands a surgical operation."

I, for one, refuse to take Prof. Hooton's "obstinate pessimism" in all its implications; nevertheless, his is a vigorous and timely call to action —on the part of everyone. A. K.

A Highway Code for Vitamin Workers

The Biological Standardisation of the Vitamins
By Dr. Katharine H. Coward. Pp. viii + 227 + 7 plates. (London: Baillière, Tindall and Cox, 1938.) 12*s.* 6*d.*

INTERNATIONAL standards for certain vitamins have been in existence since 1931. The experience of the last few years has shown that while they have been accepted readily throughout the world, a number of workers have either failed to make proper use of them or have not interpreted the results correctly. The errors are of commission as well as omission, and a rooted dislike and fear of the mathematical unknown lying beyond a simple average—usually drawn from too few animals—seems to be the most common sin.

Dr. Coward and her colleagues of the Pharmaceutical Society have for some time been leading a courageous missionary campaign among the unbelievers and have published many papers, mostly in the *Biochemical Journal*, describing how to carry out vitamin assays and how to make proper use of animals and of mathematics. These papers form the basis of Dr. Coward's book. Much new information has been added, and the author must be heartily congratulated on this timely collation.

The book is in two parts, of which the first is self-contained and describes the practical aspects of vitamin estimation. The reader can make use of this part without first having to master the second, which deals with statistical methods of interpretation. Nevertheless, the second part is extremely simply written and, as the author points out in her preface, it is to be hoped that workers who have been accustomed to fight shy of statistical methods will be encouraged to take the plunge.

Part 1 opens with a very concise account of the general principles of biological assay and of the selection and care of experimental animals. The following chapters deal separately with methods for the estimation of vitamins A, B_1, C and D, that is, of all the vitamins for which international standards have been adopted. The final chapter of Part 1 describes the way in which certain vitamins affect the estimation of other vitamins.

Part 2 outlines the rudiments of the statistical methods which are necessary for biological estimation. It then deals with the application of these methods separately to each of the vitamins. Copious numerical illustrations are worked out in full in each case. The factors governing the standard of accuracy are explained, and the way in which an experiment has to be designed and the number of animals chosen to attain a given standard of accuracy, is most happily described.

Dr. Coward writes almost entirely from first-hand knowledge and thus imparts to the book a pleasing vitality and directness of style. She is a recognized master in the field of vitamin research, and few authors have had her opportunities of trying out most methods, selecting a few and testing them over a period of years on a large number of animals. Her vast experience enables Dr. Coward to give the reader invaluable practical hints as to what should be done in the general planning of biological assay. Perhaps more important still is what she has to say about things which should not be done.

The book does not aim, as many compilations do, at giving a glossary of all existing methods: indeed the author only rarely cites methods not in regular use in her own laboratory, and then only on the best authority. As she wisely points out, a technique of assay found successful in one laboratory often fails in another. The principles of interpretation remain, however, unchanged. In working out the technique best suited to his own laboratory and in interpreting his results, the reader could not do better than follow the advice contained in Dr. Coward's book.

Like every piece of pioneering work the book is not faultless, but its merits heavily outweigh its few shortcomings. In fact, it is so good that it will doubtless become a standard book of reference.

Owing possibly to the method of presentation, the book contains a certain amount of repetition which a specialist might feel inclined to delete, but which will be welcomed by the reader approaching the subject for the first time. Some pruning should, however, be possible without loss to the latter; for example, it is scarcely necessary to give on pages 27, 125 and again on page 134 the detailed composition of the same salt mixture.

The statistical part of the book is so lucid and is likely to be used as a model by so many readers that it is a pity that the author has not mentioned the refinements introduced by "Student" since

1908. "Student" showed that the limits of accuracy calculated by the older formulæ (which are those used by Dr. Coward) are always somewhat too optimistic; the more so the smaller the number of animals used. In the case of an estimation of vitamin B_1, with only five or six animals per group, Dr. Coward's formulæ would lead to a considerable over-estimate of the standard of accuracy. The correct result can be found by entering the t-table (Fisher, "Statistical Methods for Research Workers", fifth edition, 1934, p. 158) in place of the table quoted by Dr. Coward on page 150 of the book under review.

Of serious errors there are few, and only two are likely to mislead the reader: on page 156, the three square-root signs should be deleted, and on page 162, σ in the text, the figure and the title to the figure should in each case read ε. By an obvious slip the word "ingestation" is consistently used for "gestation" on page 9 *et seq.* On page 21 in the equation of the straight line the second y should be $\bar{y}$. On page 29, line 20, "uncertain" should read "certain"; page 37, line 14, "cod liver oil" should read "test substance"; page 48, line 17, "603" should read "606"; page 148, line 24 would be clearer if the second "of" were replaced by "in"; and on page 157, μ^4 of the fifth equation should be μ_4 and μ^2 of the sixth equation should be μ_2. In a few cases authors' names are given in the text, but not in the bibliography, for example, Peters on page 67, and Phillips (1934) on page 143.

Dr. Coward writes so clearly and has succeeded so well in giving a presentation of 'statistics without tears' that the few passages of her book which are less clear may be pointed out in the hope that she will find it possible to revise them for the next edition. Thus on page 16 the paragraph on the potency of cod liver oil in different solvents will puzzle the reader who may not yet realize that the differences lie within the limits of biological accuracy. The paragraph beginning at the bottom of page 46 may also present difficulties. The author has set herself too hard a task in attempting to explain Gaddum's statistical procedure to the non-mathematical reader in the brief compass of pages 177–179. The first part of section E on correlation coefficients (page 202) has also suffered from the need of compression.

These few errors of a first edition can easily be corrected. They do not affect the fundamentally sound structure of the work.

The book is eminently readable and should prove extremely popular. One finishes its pages impressed and grateful, and one wishes that it were possible for the centres distributing the international vitamin standards to send to each new recipient a copy of this "Highway Code for Vitamin Workers".

S. K. KON.
P. WHITE.

Iraquian Hydrology

The Régime of the Rivers Euphrates and Tigris: a General Hydraulic Survey of their Basins, including the River Karun, having particular reference to their Lower Reaches within Iraq, with Information for the Use of Irrigation Engineers, etc. By M. G. Ionides. Pp. vii + 278 + 1 plate. (London: E. and F. N. Spon, Ltd.; New York: Chemical Publishing Co., 1937.) 32*s*.

AMONG the great rivers of the world, the Euphrates and the Tigris stand out with peculiar prominence, not that they are of unrivalled length—there are at least a score of rivers of greater or equal magnitude and mileage—but because they are intimately associated with the infancy of the human race. The earliest written records of humanity are linked with Mesopotamia, now absorbed in the country of Iraq, and from the beginning of history the Euphrates was "the great river" (Genesis xv, 18). The closely adjacent basins of the Euphrates and the Tigris were, in fact, the home of the Sumerians, the race to which is credited the oldest form of connected script, the cuneiform.

There is a special interest, then, attaching to a volume which sets out to put on record, for the first time in systematic form, observations of the hydraulic characteristics of these two rivers, and Mr. Ionides is to be complimented on the painstaking care with which he has assembled his material and collated his data. He acknowledges in the preface that his readings cover a comparatively short space of time and that a long term of records is very desirable. This is undoubtedly true, since the characteristics of most rivers cannot be accurately and fully delineated from short-period observations, but still a beginning has to be made, and though for engineers the present study must be considered as provisional and likely to be outdated, yet the information it contains will always have permanent value as a contribution to the fuller knowledge of the future. Mr. Ionides expresses his indebtedness for advice

and assistance to Mr. W. Allard, who was director of the Irrigation Department of Iraq from 1928 until 1933, and attributes to him the existence of records in a statistical form amenable to analysis. Mr. Allard is now serving the Ministry of Health in Great Britain and has been lent to the Inland Water Survey, which at the present time seems to be scarcely so far advanced as that of Iraq.

The drainage system of the Euphrates and Tigris is bounded on the northern and eastern sides by ranges of mountains which form a consecutive series of catchment areas with outlets facing south to south-west. The south-western side of the basin lies on the edge of the Syrian desert and slopes gently inwards towards the Persian Gulf. It is to be noted that there is a pronounced difference in the physical conformation of the courses of the two rivers. The catchment area of the Euphrates is fairly compact, and below its confluence with the Khabur, the river traverses arid and desert country for more than 700 miles without receiving any influents except insignificant storm water drainage. The catchment area of the Tigris, on the other hand, is 'feather-like' and the river receives numerous tributaries, exclusively, however, along its eastern bank. Although the basin lies within four countries, Turkey, Syria, Iran (Persia) and Iraq, it is to the last named, which includes the territory formerly known as Mesopotamia, that the river discharge is of chief value and, indeed, of vital importance.

The cultivated area of Iraq comprises two zones: the rainfall zone and the irrigation zone. In the latter, there are about 51,000 square kilometres (20,400 square miles) capable of cultivation, of which 40,490 square kilometres (16,200 square miles) are actually cultivated, while the river supply is probably sufficient to irrigate annually about 30,000 square kilometres (12,000 square miles).

The foregoing facts are of interest, but they are merely introductory to the main theme of the volume. Chapter ii describes processes of observation and presentation of data by methods more or less generally in vogue. The gauges employed are of two types: one a post, marked with a graduated scale, and the other a set of masonry or concrete steps to which scales are affixed. The question of the datum is as yet a little indeterminate. There is the G.T.S. or Great Trigonometrical Survey datum, but in out-of-the-way places where precise levelling has not yet been done, an arbitrary datum is adopted. Most of the gauges are read once a day: a few more frequently and a few once a week. Chapter iii deals with the climate, which, on the whole, is sub-tropical and arid. Nowhere in the basin is the rainfall heavy, while on the plain it is "very scanty". Temperatures on the plains range from a cool winter to a very hot summer. Frosts in winter are fairly common: July and August are the hottest months, with a mean daily temperature of about 95° F. (between 111° F. and 79° F.). Records of rainfall, except at Basrah and Bagdad, do not cover a period of more than a dozen years and (up to 1934) yield local averages varying from 49 mm. to 607 mm. (2 in. to 24 in.).

Four subsequent chapters constitute a series of detail studies, dividing each river into two sections, the Euphrates from its source to the Hindiyah Barrage and thence to the Shatt El Arab, or combined stream, and the Tigris from its source to Bagdad and thence to the Persian Gulf. Thereafter follows an examination of three features of river hydrology: river bed instability and silt; forecasting; and floods. The underlying principles of river bed instability are discussed and figures are given of general and cross-sectional instability coefficients, the latter of which reach a maximum at Bagdad and Kut of $\pm 1{\cdot}1$ metre (3·5 feet). Forecasting is an uncertain function in the present state of knowledge, and the need for trustworthy seasonal predictions of water supplies available for distribution can only be met by more extended observations in the respective catchment areas. The two rivers have their source on opposite sides of the same watershed, but owing to the longer course of the Euphrates before reaching the plain 'danger' region, the Tigris flood peak tends to arrive about a week earlier.

In the chapter on floods, the author emphasizes the difficult nature of forecasts and affirms that he has not hesitated to give estimates in which "imponderable experience" (to wit, local knowledge and hearsay) plays a large part. He follows Hazen's method in computing "per cent chances" and his nomenclature, and tabular statistics are given on these lines. Notable occurrences include the 1929 flood on the Euphrates, estimated to be the highest for a period of thirty-six years, when the maximum discharge was 5,300 cubic metres per second (187,000 cusecs) and the 1935 discharge of the Tigris at Mosul estimated at 7,000 cubic metres per second (247,000 cusecs). These may be compared with the Thames record flood of 37,000 cusecs in 1894.

There are a useful bibliography, a coloured map, and an index. The book is well printed and the diagrams, seventy-nine in number, are clear. Altogether, the volume will be of undoubted service to geographers, hydrologists and other geophysicists, and pre-eminently to river control and irrigation engineers, especially, naturally, to those engaged in the region of Iraq.

BRYSSON CUNNINGHAM.

An Encyclopædia of the Air

The Air and Its Mysteries

By C. M. Botley. Pp. xv+296+16 plates. (London: G. Bell and Sons, Ltd., 1938.) 8*s*. 6*d*. net.

IF Miss Botley had reverted to the old custom of using sub-titles when she christened her substantial volume, recently published, she could have hit on none more appropriate than "Inquire Within upon Everything connected with the Atmosphere". Meteorologists are perhaps somewhat prone to regard the earth's mantle of gases as the joint province of their own and the aviation fraternities: this book comes as a salutary reminder of the important part played by the air in almost every ramification of human activity. Here is matter that concerns physicians, physicists, psychologists, geographers, astronomers, seismologists, archæologists, photographers, botanists, ornithologists, entomologists, chemists of both the organic and the inorganic variety, radio workers, business men, shipmasters, with, of course, meteorologists and airmen, and, last but not least, lovers of the beautiful in Nature. To each and every one of these the author offers food for thought, supplemented in several cases by suggestions for mutual co-operation or original investigation.

In so doing, the author displays a range of knowledge that is rare in these days of specialization. So encyclopædic is the array of information set forth in her 290 pages of text that it may be doubted whether even the most omniscient reader of NATURE could go through Miss Botley's book without adding something to his stock of wisdom. For he who understands the muscular structure of birds and bats, and who knows that the house-fly moves its wings more than 300 times in a second, may well have neglected to inform himself of the maximum possible size of raindrops, and of the fact that the earth's atmosphere is at least 625 miles thick.

The author has the gift of a pleasant, lucid style, coupled with no small literary grace, evidently resulting from wide and well-chosen reading outside, as well as inside, the realms of science. On one point Miss Botley gives a more accurate statement of the truth than Prof. D. Brunt in his book "Weather Science for Everybody". According to the latter authority, there are "zones of silence" around the seat of *any* great explosion: Miss Botley rightly tells us that this does not happen in the case of an extremely violent explosion, such as the eruption of Krakatoa on August 26–28, 1883, when the detonations were heard at all distances up to about 3,000 miles.

It would really need a corps of reviewers to deal adequately with the multitude of aerial subjects discussed in this volume. So far as the meteorological sections are concerned, there is not much to criticize. An understatement appears on p. 111, where it is implied that the annual average of 143 thunderstorms at Leon, Mexico, is not known to be equalled or exceeded elsewhere on earth. We have the good authority of Dr. C. E. P. Brooks ("Climate", Ernest Benn, 1929, p. 126) for pointing out that Buitenzorg, Java, ordinarily suffers such storms on as many as 322 days in the year. To redress the balance, p. 183 of Miss Botley's book contains what must surely be an overstatement: "On the eastern side of Hudson Bay . . . so cold are the conditions that, in an area five times the size of England, there is not a single tree, only creeping willow".

Attention has recently been directed to a strange lack of unanimity in regard to the world's recorded extremes of low temperature. For the absolute surface minimum at Verkhoiansk (Siberia) Miss Botley, following the *Meteorological Glossary* (M.O. 225, ii), gives — 93·6° F., on January 3, 1885. In various authoritative works the figure is cited as — 90° F. Doubt exists also as to the date of the occurrence, February 1892 being adopted by some Soviet writers, who ought to know. The absolute upper-air minimum, over Java, is said by Sir Napier Shaw to be — 135° F. McAdie, however, puts it at — 133° F., the *Meteorological Glossary* at — 131·6° F., and Miss Botley at — 131° F. How, therefore, has all this promiscuity arisen?

The work under review is well worthy of the high company with which it rubs shoulders in Bell's Popular Science Books. Mention should be made of the fine series of photographic illustrations, outstanding among which are Plates II, X, XIII and XIV, representing respectively a sandstorm over the Pyramids, an example of ball-lightning, the 'banner' cloud on the Matterhorn, and a Fulmar petrel in process of 'banking'. Incidentally, the position of Plate V (an infra-red photograph of the coasts of south-east England and northern France taken from the air) is wrongly given in a reference on p. 202.

E. L. HAWKE.

Essai sur les fondements de la géométrie Euclidienne Par Julien Malengreau. Pp. 311. (Lausanne et Genène: Payot et Cie., 1938.) 8 francs.

M. MALENGREAU conceives the object of a geometrical treatise to be that of investigating the point-aggregates of a space which has been generated by the help of appropriate postulates. In the present essay, he has set himself the task of generating the most elementary space which can be the object of Euclidean geometry, where Euclidean space is understood as that space which corresponds to the conditions of our environment according to such immediate verifications as we possess. The method whereby M. Malengreau obtains this elementary Euclidean space is based upon the generation of aggregates containing an indefinite number of points, from those containing only a definite number. Such a process necessitates the consideration of all those intermediary aggregates which are of use in classifying the new points as they are obtained. But M. Malengreau is careful to introduce as few new definitions as possible; although he invents several new terms to apply to aggregates which are termed differently in classical geometry, and in some cases, uses the familiar terms in a different sense from that of classical geometry.

From the outset, his method differs radically from that of classical geometry, the definitions, postulates and theorems being introduced in logical order according to the indispensability of the ideas which they define and explain, and then only to the extent necessary to enable them to generate a new fundamental aggregate. But M. Malengreau points out that it is not possible to pass from an aggregate of lower to one of higher order, until the extensions of the members of the former in order and magnitude have been determined.

M. Malengreau maintains that the elementary space generated by his method is equal in experimental value to the general Euclidean space of classical geometry; and his treatment is original enough for one to anticipate with interest the general treatise on geometry which he is planning and to which this essay serves as an introduction.

Hydrophobic Colloids

Symposium on the Dynamics of Hydrophobic Suspensions and Emulsions held at Utrecht on the 5th and 6th November 1937, under the auspices of the Colloidchemistry Section of the "Nederlandsche Chemische Vereeniging". Pp. 181. (Amsterdam: D.B. Centen's Uitgevers-Maatschappij, 1938.) 4 florins.

THIS book forms a testimonial to the work of the Dutch school on hydrophobic colloidal solutions. It contains a number of papers on the electrical double layer, including one of special importance by H. C. Hamaker, who discusses stability in terms of potential curves. Ionic exchange is then discussed and the book ends with two papers on emulsions. It should be read by all workers on colloids, but with certain reservations. The best comment is provided by Prof. Kruyt at the end of his introduction. He says: "To-day colloid chemistry floats in water! All our results are confined to an ionising intermicellar liquid, and I can scarcely think of any satisfactory way of extending these discussions to non-aqueous systems." But why try? It must be realized that colloidal solutions fall into two main classes. First there are those the stability of which is due to an ionized surface layer, which may be formed by adsorption of ions as in hydrophobic sols, or which may be due to the presence in the particles of ionizable groups. The particle may be a polymer-molecule or a micelle, for example, proteins and soaps. Secondly, there is the rapidly growing class of substances which form stable solutions because they are soluble in the solvent and which are colloidal because of their large molecular weights, for example, rubber and the polymers generally. There is no reason why this dualism should be more disturbing in two-dimensional chemistry than in ordinary three-dimensional chemistry. It is not a bar to progress, but a clear indication of how far a particular line of attack can be followed profitably.

A. S. C. L.

Discarnate Influence in Human Life: a Review of the Case for Spirit Intervention. By Ernesto Bozzano. Translated by Isabel Emerson. (Library of the International Institute for Psychical Research, Vol. 1.) Pp. xiv+274. (London: International Institute for Psychical Research; John M. Watkins, n.d.) 8*s.* 6*d.*

IN this volume, Signor Bozzano, one of the most prolific of Italian writers on psychical research, sums up the conclusions to which he has been led in the course of many years of attention to this subject. The book will be of some considerable interest to spiritualists, since it attempts to deal in detail with the difficulty of combining, in one so-called explanation, phenomena where resort to a spiritistic hypothesis is clearly unnecessary, and other manifestations where the influence of the discarnate might to some minds be considered obvious.

Signor Bozzano advances the view that it is not a situation where the choice is between what he calls "animism" and spiritualism, but that it is one where the two are combined and interlinked to such an extent that it may be said that animism proves spiritualism. The subliminal processes are, to Signor Bozzano, the senses of the spirit still incarnate, which are only later to emerge and function in the environment proper to them. Thus instead of being an all-sufficient explanation of "psychic" phenomena they can be regarded as pointers to the only true explanation, namely, the activity of spirits still incarnate, which, when released from the body at death, fulfil their destiny in spiritual realms.

Although the theory will scarcely be considered by those to whom the existence of 'psychic' phenomena is still in doubt, it will certainly be discussed at length by psychical researchers generally, to whom this book, so well translated by Isabel Emerson, can therefore be commended.

The Pleistocene Anthropoid Apes of South Africa

By Dr. R. Broom, F.R.S., Transvaal Museum, Pretoria, South Africa

DART'S discovery in 1924 of the fossil ape of Taungs, which he named *Australopithecus africanus*, opened a new chapter in the history of the origin of man. The type skull, which unfortunately is the only one known from that locality, is that of a five-year-old child, and though there seems little doubt that Dart was right in regarding it as an ape much nearer to man than either the chimpanzee or the gorilla, some European men of science still seem to believe that it is a variety of chimpanzee or a dwarf gorilla, in spite of the fact that the milk teeth are entirely different in structure from those of the living anthropoids, and closely similar to those of man.

In 1936 I discovered, at Sterkfontein, much of an adult skull which I described as *Australopithecus transvaalensis*. It is clearly allied to the Taungs ape, but there are few points in which a comparison can be made between the two, and I provisionally placed it in the same genus. In the last two years almost continuous exploration has been going on at Sterkfontein, and many interesting further remains have been found, notices of some of which have been published in NATURE.

Until this year, nothing was known of the lower jaw except a beautifully preserved 3rd molar. We still do not know much of the mandible, but we now have a well-preserved 2nd premolar, much of what I regard as a female canine, and the incisor portion of the jaw of a young male, corresponding to a human boy of nine years, with the perfectly preserved crown of an unworn canine. This canine is unlike that of any ape at present known, but there seems little doubt that it is rightly identified as that of the male *A. transvaalensis*, from the resemblance it bears in a number of respects to the canine, which I regard as the lower canine of the female. Though little more than the incisor portion of the symphysis is preserved, it shows the sockets of the incisors, and reveals the interesting fact that the lateral incisors are considerably larger than the central ones. The shape of the symphysis is so different from that of the Taungs ape that it seems advisable to place *A. transvaalensis* in a distinct genus, for which the name *Plesianthropus* is proposed.

In June of this year a most important new discovery was made. A schoolboy, Gert Terblanche, found in an outcrop of bone breccia near the top of a hill, a couple of miles from the Sterkfontein caves, much of the skull and lower jaw of a new type of anthropoid. Not realizing the value of the find, he damaged the specimen considerably in hammering it out of the rock. The palate with one molar tooth he gave to Mr. Barlow at Sterkfontein, from whom I obtained it. Recognizing that some of the teeth had recently been broken off, and that there must be other parts of the skull

Fig. 1.

PALATAL VIEW OF SKULL OF *Paranthropus robustus* BROOM, ABOUT ½ NATURAL SIZE. THE TEETH OF THE LEFT SIDE HAVE BEEN WEATHERED OFF, BUT ARE REPLACED IN WHAT MUST HAVE BEEN NEARLY THEIR ORIGINAL POSITION. PART OF THE SOCKET OF LEFT m^3 IS PRESERVED.

where the palate was found, I had to hunt up the schoolboy. I went to his home two miles off and found that he was at school another two miles away, and his mother told me that he had four beautiful teeth with him. I naturally went to the school, and found the boy with four of what are perhaps the most valuable teeth in the world in his trouser pocket. He told me that there were more bits of the skull on the hillside. After school he took me to the place and I gathered every scrap I could find; and when these were later examined and cleaned and joined up, I found I had not only the nearly perfect palate with most of the teeth, but also practically the whole of the left side of the lower half of the skull and the nearly complete right lower jaw. The only missing parts

of importance are the halves of two molars, the crown of the left 1st upper premolar and the crown of the right lower canine. Those I still hope to discover. As, however, we have impressions in the matrix of some of the missing teeth and parts, we know nearly the complete dentition.

The skull is that of a large ape, larger than most male chimpanzees and nearly as large as

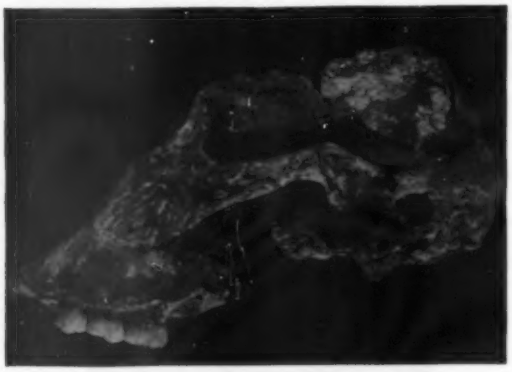

Fig. 2.

SIDE VIEW OF SKULL OF *Paranthropus robustus* BROOM. ABOUT ½ NATURAL SIZE.

most female gorillas; but it differs very greatly from both the living African anthropoids. Much of the palate is preserved in perfect condition. The whole of the left side of the sphenoid bone is also preserved; while the zygomatic arch is nearly complete. The glenoid cavity and the tympanic bone are in perfect preservation, and much of the mastoid region, and part of the occiput with a portion of the left condyle.

The glenoid cavity and the relations to the tympanic bone are of exceptional interest. In the gorilla, the chimpanzee, the orang and the gibbon, the outer part of the tympanic is situated behind the posterior glenoid process. In man, the tympanic is situated mainly below the glenoid process, and even at its outer part it forms the posterior non-articular part of the glenoid cavity. In the new fossil ape, the condition of the glenoid and tympanic is almost exactly as in man, though the parts are very much larger.

The occipital condyle is in practically the same plane as the external auditory meatus and thus farther forward than in the gorilla and the chimpanzee; which appears to indicate that the ape walked somewhat more erect than the living anthropoids.

From the portion of the brain case preserved, I estimate the volume of the brain to have been about 600 c.c. The face is remarkably flat and much shorter than in the gorilla. A curious bony ridge runs down from the inner border of the large infraorbital foramen.

The molar teeth, as will be seen from the illustrations, differ considerably in shape from those in *Plesianthropus transvaalensis*, and the 2nd premolar is about half as large again as in the Sterkfontein ape. The upper canine had been lost before fossilization, but it must have been relatively remarkably small, and the incisors, of which we have much of the sockets preserved, were also relatively small. The palate is relatively short and broad, and owing to the small size of the incisors and canines the anterior part is narrowed, and the teeth are arranged more as in man than in any of the living anthropoids. The anterior two-thirds of the right mandible are satisfactorily preserved. The symphyseal region has been broken off behind the canine before fossilization and slightly displaced. The incisors which are lost have been relatively very small, and the lateral ones are scarcely larger than the central. The canine crown is lost, but the impression of its outer side is preserved in the matrix. It is quite a small tooth, and remarkably human in shape. It is clearly very unlike the canine of *Plesianthropus transvaalensis*. The premolars have rounded crowns without any high well-developed cusps as in the living anthropoids, and are thus fairly similar to those of man, but about twice as large. The 2nd premolar differs very markedly from that of *Plesianthropus transvaalensis*, and we may thus confidently place the new skull in a new genus and species.

Fig. 3.

OCCLUSAL VIEW OF MOLARS, WITH ROOTS OF PREMOLARS, OF RIGHT MANDIBLE OF *Paranthropus robustus* BROOM.

The deposit in which the skull was found is the floor of an old cave the walls of which have probably been weathered away thousands of years ago. We may therefore suspect that the deposit is very much older than that in the Sterkfontein caves, and this is confirmed by the associated fauna. It contains a jackal, a baboon, a horse and a hyrax, which are all of different species from those at Sterkfontein, and are most probably all older.

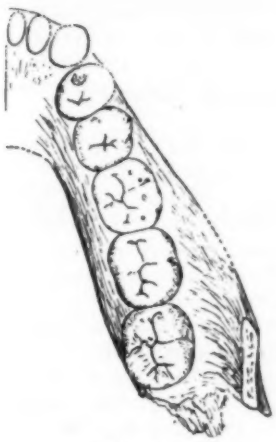

Fig. 4.

OCCLUSAL VIEW OF RIGHT MANDIBLE OF *Paranthropus robustus* BROOM. ⅔ NATURAL SIZE. THE PORTION OF THE JAW WITH CANINE AND INCISOR SOCKETS WAS DETACHED AND IS PLACED IN WHAT WAS PROBABLY ITS ACTUAL RELATIONSHIP.

The skull may be referred to as the Kromdraai (pronounced 'Kromdry') skull, and may be given the name *Paranthropus robustus*.

It seems probable that the Sterkfontein skull is of Upper Pleistocene age, the Kromdraai skull of Middle Pleistocene and the Taungs skull probably of Lower Pleistocene; though of course more work will have to be done before the geological ages of any of these skulls can be determined with more than probability.

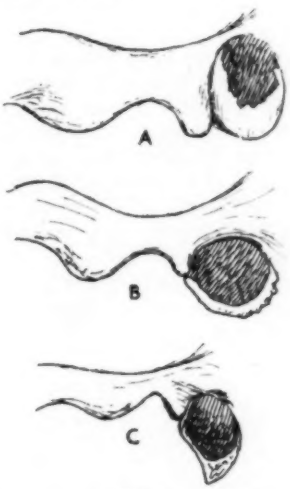

Fig. 5.

THE GLENOID AND THE EXTERNAL AUDITORY MEATUS IN (*A*) A LARGE MALE GORILLA; (*B*) *Paranthropus robustus*; AND (*C*) A LARGE KORANA MALE. ⅔ NATURAL SIZE.

Clearly, during the Pleistocene there lived in South Africa a number of large-brained anthropoids which resemble man in the shape of their premolars and in having relatively small canines, and in having the glenoid region, in at least some forms, remarkably human in structure. These Pleistocene apes are probably the modified descendants of forms that may have been widely distributed over Africa in Pliocene times, and it is probably from one of the Pliocene members of the group that man arose.

Quite certainly the conditions in Pleistocene times in South Africa were not unlike those of to-day. The apes lived on the plains and among the rocky krantzes. At Taungs most probably the apes lived in the caves. The associated animal remains seem to be the kitchen midden of *Australopithecus*.

At Sterkfontein and Kromdraai the larger bones in the caves seem all to have been introduced by

Fig. 6.

SIDE VIEW OF SKULL OF *Paranthropus robustus* BROOM. ⅔ NATURAL SIZE. RESTORED. THE PARTS IN LINE ARE KNOWN.

carnivorous animals and the small bones by owls. Nearly every bone of the larger animals has been broken in pieces. No perfect limb bone has been found, and most teeth are detached from the jaws and many of the teeth have also been broken before fossilization.

We have now a fairly good knowledge of the faunas associated with the apes. We know about a dozen fossil mammals from the Taungs caves, all extinct; about thirty mammals from Sterkfontein, nearly all extinct; and we know about a dozen from Kromdraai, all extinct except one—the living porcupine.

Social and International Relations of Science

THE growing feeling among scientific workers that they have a definite part to play in the promotion of social well-being and in international affairs found expression in a discussion in NATURE of April 23. The outcome was a suggestion that the British Association should take up the matter, and the Council of the Association put forward a proposal for the establishment of a new Division for the Social and International Relations of Science. The proposal was agreed to by a meeting at Cambridge of the General Committee on August 17. We print below the memorandum prepared for the General Committee.

At the present time a strong feeling exists that the social relations of science demand close and objective study. The question has been dealt with recently in the Press and elsewhere. At an informal meeting of persons specially interested, it was stated that there is nothing in the constitution of the British Association to prevent the establishment of machinery within that organization for the purpose desired. A resolution was thereupon addressed from this meeting to the Council of the Association, inviting the Association to establish a special department which would consider the social and international relations of science, by means of inquiry, publication, and the holding of meetings not necessarily confined to the annual meetings of the Association.

International relations were specified in this resolution primarily because of the deep interest of the American Association for the Advancement of Science in the subject. Discussion is expected to take place between officers of the two Associations, during the present summer, on the best means for international co-operation.

The Council supported the proposal to establish an organization for these purposes within the Association. They appointed a Committee to formulate a scheme for the working of such an organization, to be presented to the General Committee at the Cambridge Meeting. It is thought that the organization should work on lines in some respects different from those of a Section, and should not bear that title. The term 'Division' is therefore recommended.

The purpose of the Division would be to further the objective study of the social relations of science. The problems with which it would deal would be concerned with the effects of advances in science on the well-being of the community, and, reciprocally, the effects of social conditions upon advances in science.

The Division would be worked by a Committee, nominated annually by the Council and appointed by the General Committee. The Council should have power to appoint additional members of the Committee during the year.

The Committee should embody the existing British Science Guild Committee of the Association, inasmuch as the Norman Lockyer, Alexander Pedler, and Radford Mather Lectures, now administered by that Committee, would appropriately come within the purview of the Division.

The President of the Association and the General Officers should be *ex-officio* members of the Committee. A chairman of the Committee should be appointed for a fixed period of office. A fixed proportion of the ordinary members of the Committee should retire annually (as in the case of the Council) and should not be eligible for immediate re-election.

The functions of the Committee would be:

(*a*) To arrange meetings of the Division both at the time and place of the Annual Meetings of the Association, and elsewhere at other times, as invited or otherwise arranged; to appoint speakers and to accept or reject communications offered to the Division.

(*b*) To furnish material for the information of the public.

(*c*) To co-ordinate work dealing with the social relations of science, both at home and abroad.

(*d*) To be prepared to act in a consultative capacity and to supply information, and to that end to establish relations with organizations and persons engaged in practical administration.

(For the furtherance of the above objects, the Committee, immediately upon the establishment of the Division, should issue an announcement thereof, together with a reasoned statement of its aims, to institutions and other organizations and individuals known or likely to be interested in its work.)

(*e*) To set up sub-committees for executive purposes, or for research, inquiry, or co-ordination. If any such sub-committee should require a grant of money for its work, the Committee should be empowered to apply for such grant to the General Committee or the Council in accordance with the usual procedure relating to research committees.

(*f*) To maintain close relations with the Sections of the Association and their Organizing

Committees. In particular, there may be imagined subjects which two or more Sections might be disposed to recommend to the Division for discussion, in lieu of arranging joint meetings of the Sections. The Committee of the Division, on its part, should be enabled to invite the advice of the sectional organizations on all appropriate questions. The Organizing Sectional Committees should be kept regularly informed of the activities of the Division.

The Committee should meet regularly throughout the year, at intervals determined by itself, and in particular it should hold a meeting at or near the time of the joint meetings of Organizing Sectional Committees in January, in order to assure the relations with the Sections referred to above.

The Committee should report to the Council as and when necessary, and annually through the Council to the General Committee.

Logic and Probability in Physics*

By Dr. C. G. Darwin, F.R.S.

IN choosing a theme for my address I was in some difficulty. The main subjects of present interest in physics, the nucleus of the atom, cosmic rays, and the phenomena at deep temperatures, are being dealt with in the discussions of our Section, so that they would be excluded even apart from the fact that I cannot speak on them with authority. It would have been possible for me to choose a narrower subject, but I could not feel that this would have possessed the general interest that such an occasion demands, and so with some trepidation I am venturing on an even wider theme and am going to touch on the philosophy of our subject. This is a dangerous thing to do for one who has never made more than the most superficial study of pure philosophy, but still I do not apologize for it, because it appears to me that recent scientific history has revealed a deep schism between the professional philosophers and the scientists, and this schism is worthy of examination.

General philosophy claims to be the critical subject which lays down for all of us what we may be allowed to think, and yet it has played no part whatever in the great revolutions of human thought of the present century—those connected with relativity and the quantum theory. It might have been expected that the scientists would have been constantly consulting the philosophers as to the legitimacy of their various speculations, but nothing of the kind has happened. Since no one can dispense with some sort of metaphysic, each scientist has made one for himself, and no doubt they contain many crudities, but it would seem that a deep interest in metaphysic is a disadvantage rather than an advantage to the physicist—at least I have the impression that those of my friends who are most inclined to speculate on the ultimate things appear to be the ones whose scientific work is most hampered by doing so. Now I propose to risk a similar indiscretion. I want to embody in it the practical philosophy of a physicist, and I do not mean it as an attack on the pure philosophers, who are very reasonable people, only chargeable with the minor offence of not having made me want to read their books!

I had better begin by stating shortly the ideas I intend to discuss. There is a notable contrast between the way we think about things and the way we think we ought to think about them. We have set up as an ideal form of reasoning the formal logic which has held the field since the days of Aristotle. We rarely conform to this ideal, but instead we usually make use of arguments having no accurate axiomatic basis, which compel belief because of some large accumulation of favourable evidence. I intend to develop the idea that the old logic was devised for a world that was thought to have hard outlines, and that, now that the new mechanics has shown that the outlines are not hard, the method of reasoning must be changed. The key to the modification has already long been in our hands in the principle of probability, but whereas in the past constant attempts were made to fit this into the old system, the new mechanics suggests the possibility of a different synthesis. Though I hope this subject will be found interesting in itself, I would not have ventured to bring it forward if I had not also a very practical purpose in doing so, and that is to urge that our mathematical education both at school and university has been gravely deficient in that it has put all the emphasis on matters susceptible of rigorous proof, while it has very completely neglected the equally important subjects of statistics and probability. I shall enter into these matters at the end of my address.

* From the presidential address to Section A (Mathematical and Physical Sciences) of the British Association, delivered at Cambridge on August 19.

If we examine various examples of theories and why we believe in them, we conclude that an axiomatic basis, of the kind demanded for the operations of formal logic, is too narrow for the understanding of the physical world. Something wider is needed. Now for more than a century there has been growing up the recognition that probability plays a part in much reasoning, and that there must exist a wider system of logic which has probability as one of its features. Attempts have been made, and are still being made, to bring probability back into the narrow fold of the old logic. It appears to me that these attempts are hopeless, but before approaching the question directly I want to develop an analogy which seems to me important. Like everyone else I *feel* the compelling power of the old logic, and I cannot *feel* how when we try to go beyond it we can get the same compulsive force. But on the other hand, I *know* of a case where our thoughts are driven in one direction by a force which seems to have the same psychological compulsion as does formal logic, and yet where the result is undoubtedly wrong.

To anyone who has thought at all seriously about the world, or at any rate to anyone who has made an elementary study of mechanics, I suppose there is nothing more absolute than the law of causality. By this I mean that the future is completely contained in the present. Passing over obvious examples where this is true, like the path of a projectile or the orbit of a planet, we may take an extreme case where we might expect our faith in the principle would be most severely tried. Take the typical case of chanciness, the tossing of a coin. We know that in a general way there is an even chance of heads or tails, even though we sometimes hear of gifted individuals with muscles so delicately adjusted that they can control the event. But in the ordinary way the tossing of a coin is complicated by being produced by a living organism, so let us simplify the problem by designing a catapult of some kind to project it. Which of us does not believe the coin would fall the same way every time if such a mechanism could be made with really complete precision? When the machine fails to make it do so, we say it is because there may have been a speck of dirt in the lubricant or something like that. In other words, we do not feel that the fall of the coin is determined by chance, but we regard the uncertainty we observe as due to our ignorance of all the detailed causes. Ignorance is a confession of incompetence, and so we regard the existence of chance as a blemish in our otherwise admirable characters. This feeling goes very deep, since we are prevented by it from having the complete control of our surroundings that we somehow think should be our due. We start prejudiced against probability and in favour of causality.

So much for what we *feel* about causality; and about thirty years ago this feeling would have been regarded as a piece of inescapable reasoning, with the same kind of compelling power as a logical syllogism. We still have the feeling, but now we know it is wrong, and what is more, we know that it is wrong for a reason we never thought of. To understand this oversight we must review the recent history of atomic theory.

[There follows a review of the history of the quantum theory with special reference to the way in which it disposes of the difficulty of causality.]

The history of the quantum theory serves as an analogy to the deeper question of what is wrong with the old logical processes. Just as we used to feel the all-pervading compulsive force of causality, so we feel the all-pervading force of pure logic. Just as we felt that classical mechanics provided no room for anything beyond itself, so we feel that the old logic is the only admissible kind of reasoning. We knew that certain things led to the Old Quantum Theory and obstinately refused to fit into mechanics, and we know that the principle of probability can cover many things outside the old logic. Many men tried to force the quantum into the classical system, and many are still trying to bring probability within the fold of the old logic. I do not believe it can be done. This is not the occasion, nor have I the capacity, for a deep argument on the place of probability in logic, but one of the most convincing ways of seeing it may be found in the consideration of another branch of physical theory, the kinetic theory of gases.

The greatest contribution to the subject was that of Gibbs, who recognized that there had to be a big assumption somewhere and made it quite frankly and without attempt at justification. The works of Gibbs are not easy reading; in both his great works he attends to every detail with a particularity that is really rather tedious, whereas his basic ideas are thrown at the reader almost without explanation. The idea of a canonical ensemble is a really beautiful idea once you understand it, but where does it come from? An ensemble is an idea which will be unfamiliar to many, so I had better explain it. We want to know something about the behaviour of a complicated system composed of a great many parts; say we want to know the pressure of the gas in some vessel. Gibbs considers a very large number of possible states of motion of the set of molecules, which have some character in common such as their total energy, but which are otherwise unrelated. Though each specimen of the

motions is quite independent of all the others, he looks at them all together; this explains the word *ensemble*—I do not know why he had to take a French word—and makes the assumption that the pressure of the gas is correctly given by the average of all the specimens. The actual gas in the vessel at any instant is one of the specimens; in its motion it passes into configurations corresponding to others, but only after a fantastically long time would it go through even a perceptible fraction of the whole ensemble. Gibbs is assuming that the behaviour of the actual gas will be determined by the average of the uncountable millions of specimens in the ensemble.

With the old mechanics all this involved ideas which for many readers were distinctly hard to accept. The principle of probability, embodied in the averaging over the ensemble, was frankly laid on top of the logical principles of Newtonian mechanics, and to anyone believing that probability would ultimately be brought down to the old logic the association was most repellent. But we can now see that Gibbs was a prophet far ahead of his time—and indeed, to be frank, far ahead of his own knowledge—for the new mechanics accommodates the ensemble very much more easily than did the old. The new mechanics has shown us that it is impossible to know how the individual molecules are moving, because when one undertakes an experiment to see, that experiment automatically alters the condition of the gas and so fails to tell what was wanted, the state of the molecules without the experiment.

In the old days one used to feel that the validity of Gibbs's idea would be spoilt by some skilful experimenter who would really observe the motions of the individual molecules and would therefore rule out the legitimacy of averaging over the *whole* ensemble, but we now know that there is no danger of this. The real gas in the vessel is not merely one specimen of the ensemble, unrecognizable only because of our clumsiness; it is itself the whole of the ensemble. We used to think of the gas as *either* in the state *A*, *or* in the state *B*, *or* in *C*, but according to the new physics we have to think of it as in *all* the states *A and B and C*. The distinction is typical of the change we must make in our habits of thought, and most of us resist this change strongly, for we find we can scarcely help asking: 'But which state was it really in?' As I have said, we used to be ashamed of ignorance, but we must now realize that *this* ignorance is one of the things that makes the world possible. The principle of probability, which used to be loosely superposed on the old logical principle, is now with the new mechanics fully united with it in a higher synthesis.

Before leaving Gibbs I would like to refer to one thing in his book, where I think he has not even yet come into his own. He considers various types of ensemble of increasing generality. In the micro-canonical the members all have the same energy. Now we never know the exact energy of the gas in a vessel, so that a better idea is the wider one of a gas at a given temperature which therefore has a certain range of admissible energies. This is represented by Gibbs's canonical ensemble, and it is the main one that he uses. In both these the number of atoms in the ensemble is constant. But in the last chapter of his book Gibbs introduces a still wider ensemble. He calls the ones with a constant number of atoms *petits ensembes*, which I shall translate as petty ensembles, and regards them as parts of a grand ensemble in which the total number of atoms is not fixed. He uses the idea to some extent in connexion with semi-permeable membranes, but on the whole does not get far with it.

As in much of Gibbs's work, it is the idea itself, rather than what he does with it, that is important. This idea of the grand ensemble is not yet incorporated in the new physics. In the quantum theory we take a number of electrons and nuclei, and, allowing for their interactions, we construct something that is practically the canonical ensemble. But we take fixed numbers of them—this is partly reflected in the technical process of using normalized wave-functions. Now in an experiment dealing with a large number of particles we are never really sure exactly how many there are, and to assume this number is much like assuming a constant energy for them. If the canonical ensemble is a better idea than the micro-canonical, then the grand ensemble is superior to the petty ensemble. In the new mechanics nobody has yet succeeded in making anything of it, or has made any proposal how to do so, but I will venture the forecast that when some of our present difficulties in the quantum theory are cleared up, it will be found that we shall be using the grand ensemble with its indefinite number of atoms.

Reverting to my main theme, what is the moral of all this? It is that the new physics has definitely shown that Nature has no sharp edges, and if there is a slight fuzziness inherent in absolutely all the facts of the world, then we must be wrong if we attempt to draw a picture in hard outline. In the old days it looked as if the world had hard outlines, and the old logic was the appropriate machinery for its discussion. Things went wrong when it was found necessary to call in the help of the principle of probability; this appeared first as an alien, but there was hope in the old days that the alien might be naturalized. It has

resisted the process and we now recognize that it cannot be assimilated, because it provides the necessary step to a wider reason, that of the new fuzzy world of the quantum theory, a world which is not contained in the old. How far it will be possible to make a full synthesis of the new and the old I do not know, but I like to think there is something in my analogy from the history of the quantum theory, and to suppose that we are still in the condition corresponding to the Old Quantum Theory, and that some day a real synthesis will be made like that of the New Quantum Theory, so that there will be only one thing in the world that has not indefinite outlines, and that will be a new reformed principle of reasoning.

There may be a feeling among some that the very general suggestions I have been making are open to every sort of criticism. Perhaps they are right; as I have said, it is part of my doctrine that the details of a physicist's philosophy do not matter much. But whether it is wrong or right, my next point is one on which I do very much hope that there may be a consensus of agreement. This is that the subject of probability ought to play an enormously greater part in our mathematical-physical education. I do not merely mean that everyone should attend a course on the subject at the university, but that it should be made to permeate the whole of the mathematical and scientific teaching not only at the university but also at school. To the best of my recollection, in my own education I first met the subject of probability at about thirteen years of age in connexion with the problems of drawing black and white balls out of bags, and my next encounter was not until the age of twenty-three, when I read a book—I think it was on the advice of Rutherford—on the kinetic theory of gases. Things are better now, but mathematicians are still so interested in the study of rigorous proof, that all the emphasis goes against the study of probability.

This is not the place to describe a revised scheme of education. I would only say that it is not special new courses that are needed, but rather a change in the spirit of our old courses. When a boy learns about the weighing machine, emphasize its sensitivity, and consider the length of time that must be taken for the weighing. When he has a problem on projectiles, make him consider the zone of danger and not merely the point of fall. At a rather higher level, but still I should hope at school, introduce the idea of a distribution law; for example, in doing central orbits work out Rutherford's law of scattering. Calculate the fluctuations of density of a gas, or the groupings in time of the scintillations of α-particles. All these things ought to be examples of a familiar train of thought, and not merely a highly specialized side-branch of mathematics first met at the university. It is the incorporation of probability in the other subjects on which I want to insist, but there will of course remain some higher aspects—things like least squares or significance tests—which are still to be treated in separate university courses. Even these I should hope would come to be recognized as subjects of central interest and not, as they are at present, relegated to a remote corner of specialized study.

If these reforms are carried out, I shall hope that generations will grow up which have a facility that few of us at present possess in thinking about the world in the way which the quantum theory has shown to be the true one. The inaccuracies and uncertainties of the world will be recognized as one of its essential features. Inaccuracy in the world will not be associated with inaccuracy of thought, and the result will be not only a more sensible view about the things of ordinary life, but ultimately, as I hope, a fuller and better understanding of the basis of natural philosophy.

Obituary Notices

Sir John Snell, G.B.E.

BY the death of Sir John Francis Cleverton Snell, the electrical profession has lost an inspiring leader, and all who knew him mourn the loss of a great-hearted and much-loved friend.

The son of Commander Snell, he was born in 1869, at Saltash, Cornwall, the county which produced Trevethick, Humphry Davy and other pioneers. Being unable to enter the Navy through defective eyesight, he decided to adopt an engineering career. He became a student of King's College, London (of which, in later years, he was elected a fellow), and after gaining valuable experience with Woodhouse and Rawson, and Crompton and Company (for whom he laid a complete system of underground mains in Stockholm), he became chief assistant to the late General Webber, and in 1893 became resident engineer to the Vestry of St. Pancras. From 1896 until 1906 he was borough electrical and tramways engineer of Sunderland, where he designed a new, and the main, power station and a complete system of electrical tramways.

In addition, Snell found time to publish in 1906 a work on the "Distribution of Electrical Energy",

to be followed later by a complementary work on "Power House Design", which for many years were regarded as standard works.

All this time, Snell's virile brain envisaged a much wider sphere of activity, and as his advice on technical problems was sought with increasing frequency he took the plunge and established himself as a consultant in Westminster. His practice rapidly increased, and also his reputation as an expert witness, and as an authority on the rating of electricity undertakings. In 1910, he amalgamated his practice with that of Messrs. Preece and Cardew, the new firm being known as Preece, Cardew and Snell.

Perhaps Snell's outstanding achievement in these years was in connexion with the acquisition by the State of the telephone service. He was the principal technical witness for the Crown in the arbitration proceedings, and was in the witness-box for thirteen days. His case was prepared with that meticulous care and accuracy which distinguished him throughout his career, and as a result, he was largely instrumental in saving the country more than £8,000,000.

Snell received the honour of knighthood in 1914, and later, as a reward for further public services, he was created a G.B.E. in 1925. He was retained as electrical adviser to the Board of Trade on matters such as the regulations for the safety of the public. Owing to the growing importance of electric supply as a public utility, the Government of the day passed the Electricity (Supply) Act, 1919, for the reorganization of the industry, and placed the control in the hands of an independent body of experts known as the Electricity Commission. Snell was persuaded to accept the office of chairman (though at a considerable financial loss to himself), a position which he adorned until his retirement in January last.

In 1925, Snell was chief technical adviser to the Weir Committee, the recommendations of which were embodied in the Electricity (Supply) Act, 1926, which provided for the re-organization and co-ordination of electrical generation on national lines, under the direction of a new body, the Central Electricity Board, a function of which was to interconnect by means of the 'Grid' the most efficient power stations and close down the smaller and less efficient plants. The generating side of the industry being thus placed on a soundly organized basis, he turned his attention to the reorganization of the distribution side, envisaging the reduction of more than six hundred separate undertakings, which had grown up in somewhat haphazard fashion, to a much smaller number, by means of amalgamation or acquisition on fair terms. He was a member of the McGowan Committee which reported its conclusions to the Government in 1936. The Government has announced its intention of promoting legislation to this end.

The outstanding achievements of Snell's career may be summarized as (1) his work for the country in connexion with the acquisition of the telephones; (2) the reorganization of generation into one orderly whole and the establishment of the 'Grid'; (3) the unification of the frequency throughout the country to a standard of 50 cycles in place of various frequencies ranging from 25 to 100 cycles; (4) the encouragement of a standard of A.C. voltage of 400/230 which, though not yet universal, is making encouraging progress; and (5) the encouragement to electrical undertakers to take long views—especially with reference to rural electrification.

Sir John Snell was president of the Institution of Electrical Engineers in 1914–15, and was awarded the Faraday Medal in March last, in recognition of his distinguished services to electrical science: vice-president of the Institution of Civil Engineers in 1926–31 and only ill-health prevented his accepting the presidency: past-president of the Incorporated Municipal Electrical Association in 1902–3: past-president of the British Electrical and Allied Industries Research Association in 1928–29: president of Section G (Engineering) of the British Association in 1926 (Oxford meeting).

Though it will be obvious that Snell's opportunities for recreation were scanty, he was keenly interested in the petrological study of rocks, particularly those of igneous and metamorphic origin. In late years he made a special study of the contact minerals associated with the aureole of metamorphism surrounding the Cornish granites. He was always a great bird lover, and in his younger days he used to tame various wild birds to come to the hand.

The present writer, who enjoyed his friendship for more than forty years, and who for a decade was in almost daily touch with him, would give the following impression of Sir John's character. He had the judicial mind to a marked degree. In his conduct as chairman of conferences and inquiries, he was always dignified, always fair, and those to whom he had to announce an adverse decision never doubted his integrity and impartiality. To all who came in contact with him, whatever their station in life, he showed a fine old-world courtesy.

T. P. WILMSHURST.

Mr. E. M. Nelson

BY the death of Edward Milles Nelson on July 20, at the ripe age of eighty-seven years, a great microscopist has passed away. He was the son of a doctor, and after a brief period of study at Corpus Christi College, Cambridge, he entered the service of a telegraph company and was for a time engaged in laying submarine cables along the coast of South America, and between the Shetlands and the mainland. Even at this period, he was never so happy as when testing the performance and optical qualities of a telescope, sextant or other optical instrument.

Nelson afterwards settled in London, and in 1876 joined the Quekett Microscopical Club, of which he later became president for three successive years (1893–95), and contributed a number of papers to its *Journal*. He now devoted himself more and more to work with the microscope, being much more interested in the theory, construction and use of the optical parts of the instrument than in the objects examined. He had an acute controversy with Abbe respecting the proper conditions for obtaining the best performance of microscope objectives of high numerical aperture. Abbe maintained that a small

(pin-hole) stop in the substage condenser was the proper combination, whereas Nelson held that a large aplanatic cone is essential, and this was afterwards proved to be correct. His views on this subject were contributed in a paper to the *Journal of the Quekett Microscopical Club* (4, Ser. 2, 116; 1890).

Nelson was also a fellow of the Royal Microscopical Society, to the *Journal* of which he communicated some two hundred papers and notes between 1881 and 1914. He was likewise president of this Society for three years (1897–99).

Possessed of very keen eyesight and unlimited patience, Nelson by his method of 'critical illumination' demonstrated many structural details previously unknown in diatoms and other microscopic forms of life, and in 1882 exhibited at the Royal Microscopical Society. Nobert's 19th band resolved for the first time in England. He also devoted much time to photomicrography with conspicuous success, and contributed the fine series of photomicrographs which illustrate the 1891 edition of "Carpenter on the Microscope", edited by Dallinger.

Nelson was also interested in the telescope, upon which he had privately published a little book in 1893, and he aroused the interest of Col. Gifford in this instrument, who, guided by Nelson, computed apochromatic telescope object glasses with very perfect corrections. The designing of mathematical scales and rules and the calculation of mathematical tables, with special reference to optics, were other subjects at which he worked. Nelson was also interested in ancient stone circles and made a considerable study of them, resulting in the publication of a small book on the subject, "The Cult of the Circle Builders".

In private life, Nelson was deeply religious and an admirer of classical culture in its proper sphere. He will be greatly missed by microscopists, for he was always ready to place his unrivalled knowledge and technique at the disposal of all—and they were many—who sought his help. R. T. HEWLETT.

News and Views

Sir Albert Seward, F.R.S.

BY the election of Sir Albert Seward as president of the British Association for the meeting to be held in Dundee next year, botany again assumes the presidential dignity after a comparatively short interval, since Prof. F. O. Bower was president of the Bristol meeting in 1930. Sir Albert's work and influence have been, and still are, very widespread in scientific research and in guiding the destinies of science and academic administration. For thirty years (1906–36), he held the chair of botany at Cambridge, which, since his retirement, is being filled by one of his former students, Prof. F. T. Brooks. For some years before Sir Albert's election to the chair at Cambridge, he had been fellow and tutor at Emmanuel College, and for sixteen years, University lecturer in botany; so his connexion with Cambridge has been a very long one. During 1915–36, he was Master of Downing College, and in 1924–26 Vice-Chancellor of the University. Thus has he been able to play a large part in academic administration at Cambridge for which his scientific attainments and personal qualities were admirably suited. He is a fluent speaker with an exceptional fund of sharp humour. Most of Sir Albert's scientific work has been associated with palæobotany, and his name is joined by botanists with those pioneers who were responsible for lifting botany from the stagnant condition in which it was in Great Britain several decades ago, to the very live condition in which it finds itself to-day.

SIR ALBERT'S palæobotanical work has proved of inestimable value to present-day concepts of plant evolution and the distribution of plants in geological time. These researches have been published over a long period of years, and still continue. His more general works include the "Wealden Flora" and the "Jurassic Flora", both in the British Museum Catalogue series, and "Fossil Plants and Tests of Climate". Students of botany and geology have for long been indebted to him for his "Fossil Plants for Students of Botany and Geology" in four volumes, while his more recent book "Plant Life Through the Ages" is a pattern of conciseness and clarity of style. His particular scientific interest in recent years has been the study of plants in past geological ages with particular reference to their distribution over the world and the indications they give of climate in geological time. But he has always fostered the study of botany in all its aspects and not merely as regards his own special interest. In more general fields, Sir Albert's influence has been even more profound. He was president of the International Botanical Congress held at Cambridge in 1930; president of the Geological Society of London in 1930, and president of Section K (Botany) of the British Association in 1903 and again in 1929. He has served on the Council of the British Association and was one of the local secretaries for the very successful Cambridge meeting in 1904. He was a vice-president of the recent Cambridge meeting. Since 1934 he has been foreign secretary and a vice-president of the Royal Society. During his academic career, and since his retirement, his work has received well-merited recognition from many sources. He is honorary member of most national academies and societies and was awarded a Royal Medal of the Royal Society in 1925, the Wollaston Medal of the Geological Society in 1930 and the Darwin Medal of the Royal Society in 1934. His influence and advice have not passed with his resignation, for he is now a trustee of the British Museum and a member of the Advisory Council of the Committee of the Privy Council for Scientific and Industrial Research. With

the British Association, he has visited Canada, Australia and South Africa, and is otherwise widely travelled. Sir Albert's election to the presidency of the British Association will be welcomed by all men of science, especially botanists and geologists.

Cambridge Meeting of the British Association

THE meeting of the British Association which has just closed will long be remembered by all who attended it. At the first meeting of the General Committee, it was agreed to form a Division for Social and International Relations of Science (see p. 380), which may well prove a vital step in the history of the Association. Lord Rayleigh's address was received with much enthusiasm, and a specially warm welcome was given to Sir J. J. Thomson, who moved a vote of thanks to the president for his address, and also to Dr. G. D. Birkhoff, past president of the American Association for the Advancement of Science, who, as spokesman of the delegation from his Association, expressed his desire to see active co-operation between the British and American Associations in the cause of international friendship. The customary announcement at the close of the inaugural meeting, made by Dr. O. J. R. Howarth in the absence of the general treasurer, Lord Stamp, of the number of tickets issued for the meeting, showed that the attendance, 2,795, while not a record, was highly satisfactory. The services of broadcasting were utilized to bring the Association's activities before a wider audience in Great Britain and also in the United States. Prof. Allan Ferguson broadcast an account of the opening meeting through the B.B.C., while on August 19, Lord Rayleigh and Sir Richard Gregory were 'interviewed' before the microphone by Mr. Watson Davis, director of Science Service, and the 'interview' broadcast in America.

THE setting at Cambridge for the meeting was of course ideal, and the University and individual colleges showed their traditional hospitality. In addition to the discussions and papers before the several sections, members had an opportunity of inspecting an exhibition of old and historic scientific instruments, which appropriately included apparatus used by Sir J. J. Thomson and by Lord Rutherford, of seeing demonstrations and exhibits of gold films produced by Prof. C. S. Gibson and his collaborators, and other more 'sectional' exhibitions. The officers of the Association who have been elected for 1939 are as follows: *President*, Sir Albert Seward; *General Treasurer*, Prof. P. G. H. Boswell; *General Secretaries*, Prof. F. T. Brooks and Prof. Allan Ferguson; *New Members of Council*, R. W. Allan, Prof. F. E. Fritsch, Sir Richard Gregory, Prof. C. Spearman and Dr. C. R. Fay. Future places of meeting of the Association will be Dundee (1939), Newcastle-on-Tyne (1940), Belfast (1941) and Birmingham (1942).

Impressions of Cambridge

A CORRESPONDENT writes: "Cambridge is the best of all places for the British Association to meet. There was an air of activity and exhilaration throughout the week, and the organization was carried out with extraordinary smoothness. There were almost too many receptions, dinners and garden parties; perhaps one could wish for a little more time for those discussions behind the scenes which are the most valuable feature of these gatherings. The great novelty of the meeting was, of course, the formation of the Division for the Social and International Relations of Science. It was astonishing and encouraging to find the project so enthusiastically received by the widest variety of scientific workers. It has lit up many people's imaginations, and given them a chance to devote themselves intelligently to something which offers a hint of usefulness in an increasingly lunatic world. Perhaps the shadow of the world outside has never hung so menacingly over a scientific meeting; many there felt that all they cared for intellectually might have vanished before long. It was noticeable that the most eager supporters of the new Division were often those whose own research happened to be particularly 'pure'. Those who complained in private that the cobbler ought to stick to his last usually turned out to be engaged on semi-applied research. It is, for example, interesting that the more abstract kind of physicists tend to be far more socially interested than people busy with traditional chemistry."

"DARWIN'S was easily the most exciting presidential address, and a model which other sections might usefully study. It had the great advantage that the intelligent layman could listen to it and not waste his time; and yet it also contained ideas enough to set professional scientists and philosophers arguing for weeks. Childe's and Southwell's were also nice pieces of work, and Griffith Taylor's highly entertaining. For pure science, Blackett's Saturday morning talk on cosmic rays was unsurpassed. The trouble is, one wants to go to so many lectures that are taking place simultaneously. But still, an energetic person could have heard something from Wells, Bohr, Darwin, Keynes, Blackett, Shapley and Huxley—which is not such a bad bag for a week's holiday."

Art at the British Association

A COLLECTION of photographs taken by members of the scientific delegation from Great Britain to the Indian Science Congress Association's jubilee meeting in January of this year was exhibited in the reception room of the British Association at Cambridge. Some of the photographs were of scientific personalities, others of Indian scenes and inhabitants, whereas several gave beautiful impressions of certain well-known Indian buildings at night, flood-lit and illuminated. A very pleasing innovation at this year's meeting, too, was the exhibition of works of art by members of the Association, which demonstrated very clearly that genius is not confined to a single avenue of interest. Many outstanding men of science are known to be accomplished in one or other of the arts, especially music, but this exhibition must have proved a pleasant surprise to many. Well over a hundred examples were exhibited, the chief among them being oil and water colour paintings, though examples also of ware, metal-work and

hand-printing and weaving were on view. The arrangement of the exhibition would have reflected credit on the Royal Academy itself. All three members of the Bragg family have clearly found the painter's palette a valuable means of utilizing the little leisure at their command. Sir William Bragg, president of the Royal Society, showed an attractive study of aloes, while landscapes were also exhibited by his son, Prof. W. L. Bragg, Cavendish professor of physics in the University of Cambridge, and by his daughter, Mrs. Carol.

MAJOR C. E. S. PHILLIPS, secretary of the Royal Institution, and Mrs. Phillips, are known by many to be artists of considerable taste. Between them they showed six of their many paintings, one of them being "On the Purbeck Hills", by Major Phillips, which was exhibited in this year's exhibition at the Royal Academy. A beautiful interior of the Cathedral Church of Christ, Oxford, was exhibited by Emily Vaughan Jenkins. One of the most interesting exhibits was a portrait of a spinster by Joyce Gardiner. The slightly embittered and very grim expression made the portrait live, and the title "Frustration" made the picture itself. Three landscapes by the late Dr. William Bateson, president of the British Association in 1914, and two by Mrs. Bateson showed an obvious love of rugged scenery. Three very beautiful paintings executed by the late Lady Robertson during the meeting of the British Association in Canada in 1924 were exhibited by Sir Robert Robertson, formerly Government Chemist. E. N. Willmer, lecturer in physiology in the University of Cambridge, is known to spend much of his holiday periods painting landscapes; here he showed three examples of what is clearly a successful and enchanting hobby. There is also a good portrait of Dr. F. F. Blackman, emeritus reader in botany in the University of Cambridge, by one of his colleagues, G. E. Briggs. Another by Briggs—"Cineraria"—besides being a poem of colour, also brings out the plant physiologist in the painter. The wilting of the leaves and the florets is strikingly natural.

Fossil Anthropoids in South Africa

FURTHER discoveries of the fossilized remains of anthropoids in South Africa, which were announced on behalf of Dr. Robert Broom of the Transvaal Museum during the meeting at Cambridge of the British Association (see p. 377 of this issue of NATURE), constitute an addition of the first importance to the evidence relating to the early history of man and his precursors which has been accumulating in South Africa since the discovery of Rhodesian man in 1921 and the later discovery in 1925 by Prof. Raymond Dart of the Taungs skull, *Australopithecus africanus*. The doubts which had been expressed whether the latter might not be a young chimpanzee or gorilla, and not, as Prof. Dart maintained, more closely related to the human stem than any fossil anthropoid then known, may be regarded as having been finally resolved by Dr. Broom's discovery of the Sterkfontein skull two years ago, to which he gave the name of *Australopithecus transvaalensis*, but for which his later discoveries now recorded lead him to adopt the significant nomenclature of *Plesianthropus*, expressing not only its generic difference from *Australopithecus*, but also its even closer relationship to man in the scale of development. This, however, does not close the tale of remarkable additions to our knowledge for which we are indebted to Dr. Broom. The story of how he rescued from the dangers of oblivion the fragments of still another and even more important relic, will command a tribute of admiration from all for his acumen and persistent energy in the pursuit of scientific discovery. He has been rewarded by the acquisition of what must be regarded as the most important piece of evidence now in existence relating to the evolution of man's ancestry. From fragmentary bones of the skull, the teeth, and the reconstruction of missing parts from the matrix, Dr. Broom has been able to reconstruct the Kromdraai skull, now classified as a new genus, *Paranthropus robustus*, and not merely coming closer in certain details to man than any previously known fossil anthropoid, but actually in line with man. Equally important is Dr. Broom's conclusion as to its dating, for he is now able to say, subject to further geological investigation, that while *Australopithecus* is regarded as probably Lower Pleistocene, the Kromdraai skull is Middle, and the Sterkfontein skull Upper Pleistocene.

Russian Astronomers

THE Polish journal *Acta Astronomica*, in its July issue, states that the following members of the staff of the Pulkovo Observatory have been imprisoned: I. A. Balanovsky, N. I. Dneprovsky, B. P. Gerasimovič (director), P. I. Iaschnoff, B. W. Noumeroff (director of the Astronomical Institute at Leningrad, who is believed to have been shot), N. W. Zimmermann. The Editor of *Acta Astronomica* states that it would give him great pleasure to be able to refute this statement, a sentiment which we are sure scientific workers everywhere will echo.

Backward Peoples: a Proposal from Holland

THE Netherlands Commissie voor Internationale Natuurbescherming (Netherlands Committee for the International Protection of Nature) has prepared through its recently constituted Committee for the Preservation of Primitive Races a general statement of the problem with special reference to the primitive peoples of the Dutch possessions in New Guinea. To this are added some suggestions as to how best to deal with the difficulties which will arise, or have already arisen, if and when peoples living in the stone age, who in some instances previously were not even aware of the existence of the white man, are suddenly brought into contact with the blessings (aeroplanes, motor-cars, radio) and the curses (alcohol and venereal disease) of Western civilization. A useful point is made, frequently overlooked, that an even greater danger than the white man in the matter of exploitation is the neighbouring native people of slightly higher culture which has assimilated or acquired some of the elements of white civilization. This statement of the problem is restrained, but well informed. Its

details will be familiar to those who have studied the effects of contact between primitive and Western culture and the irreparable disasters which have followed upon such contacts in the last hundred years.

In putting forward certain suggestions as to how best to deal with the situation in areas in which the natives are at present virtually untouched, such as parts of New Guinea, the islands of New Britain, and the Congo, two principles are enunciated, one ethical, namely, that the ruling power must not restrict the natives' opportunities of ordered cultural development, the second that in the interests of science opportunity should be preserved for study of native cultures before they are hopelessly corrupted by unregulated contact with the worse elements in Western civilization. Accepting the view that the interests of the native should be the first consideration, since commerce and industry may be trusted to look after themselves, the committee suggests that reserves should be created, not for the preservation of native tribes and cultures as museum pieces, but in order that these backward peoples may be led to develop gradually under supervision and strict regulation of contacts, cultural and other, in a slow but healthy upward progression, in which the elements of their own culture will be assimilated in higher forms of civilization. It will be seen that the ideal formulated by the Dutch Committee is sufficiently in accord with the views of those in Great Britain, who press for a scientific approach to the problem of the future of backward peoples, to warrant co-operation in the attainment of what is the common end. In any event, they will agree with the committee that the problem is urgent and immediate.

Jubilee of the American Mathematical Society

The fiftieth anniversary of the founding of the American Mathematical Society, which is being celebrated early in September at Columbia University, New York City, in connexion with the annual summer meeting of the Society, is unusual among jubilees of learned societies in that the principal founder of the organization in 1888 is serving as chairman of the committee in charge of the jubilee celebrations. Prof. Thomas Scott Fiske, now emeritus professor of mathematics in Columbia University, took the initiative in bringing together six mathematicians fifty years ago to establish the New York Mathematical Society, having received his inspiration to do this from his attendance at meetings of the London Mathematical Society while a student at Cambridge the preceding year. Dr. Fiske, as secretary of the young society, was indefatigable in his efforts to increase its membership, and succeeded so well that in 1891 the Society was strong enough to begin publication of the *Bulletin of the New York Mathematical Society*, which has been continued to the present time as the official organ of the Society, its name, of course, having been changed to correspond to the change in name of the Society to American Mathematical Society in 1894.

In 1900, the journal entitled *Transactions of the American Mathematical Society* was established by the Society for the publication of research papers. In the course of time the service of the Society to its membership in the promotion of mathematical research has come to include also an annual course of lectures on recent advances in some specific field of mathematics, and the publication of these in a series of Colloquium Publications, now numbering twenty-four volumes, the Josiah Willard Gibbs lectureship on applied mathematics, the maintenance of a library especially strong in relatively obscure journals, the award from time to time of several endowed prizes and the holding of ten or more meetings annually for the communication of approximately five hundred research papers. For many years Columbia University has provided office space for the Society, and more than half the regular meetings of the Society have been held in the University.

The Centro Volpi di Elettrologia

Count Volpi di Misurata, whose name is associated with many important Italian electric companies, has decided, in the interests of science, to create an institution in Italy to promote the knowledge of, and research in, electrical science. He has presented the magnificent Vendramin-Calergi Palace in Venice to serve as a home for the new institution which will be known as the Centro Volpi di Elettrologia after its founder. It is so arranged that it works in harmony with other existing Italian scientific societies. Its principal object is the improvement of electrical knowledge by means of new cultural exchanges between Italian and foreign scientists. Its main activities will be to publish a bulletin giving summaries of recent Italian researches, translated into various languages in different editions for distribution abroad. It will also promote international congresses and meetings of men of science in the quiet Venetian palace so that they may advance electrical knowledge by exchanging ideas on specific scientific questions.

We have received a copy of the first bulletin of the Centro Volpi di Elettrologia in English. It illustrates briefly the activities of and the schemes initiated by the Centro Volpi. It reports in the form of short abstracts all Italian publications dealing with electrical subjects. Great pains have been taken with the documentation of the bulletin. Each abstract is of such a size that it can be cut and gummed on an international card in accordance with the resolutions and recommendations of the World Congress of Documentation. Later on, should some article appear which is important either on account of new ideas or results, or because it serves as a basis for cultural exchanges, an amplified summary will be given in addition to the usual notice. In this bulletin an interesting article on "Acoustical Research in Italy" is given. The plans and sections of the new acoustic laboratory in the national electrotechnical institute 'G. Ferraris' in Turin is described. At present the laboratory has in use four reverberating rooms and two sound-absorbing rooms. When completed it will have a sound-proof room for microphonic calibrations and acoustimetric experiments.

Safety in the Chemical Industry

IN 1928, the council of the Association of British Chemical Manufacturers decided to prepare and issue to its members for their guidance a set of model safety rules for use in chemical works. These rules were based on the Factory and Workshop Act, the Chemical Works Regulations, the Electricity Regulations and similar statutory provisions, together with other precautions suggested from experience, and they represented the first attempt to draw up a comprehensive safety code for the chemical industry. The first part of the model rules, consisting of the proposed safety rules in concise form, was completed and issued in provisional form early in 1929. Various amendments and additions have been suggested in the light of the experience gained during the past nine years, and this part has now been issued in final form covering the provisions of the new Factories Act, 1937. It is in the nature of an introduction to Part 2, the first section of which was also issued in 1929, and it is hoped to revise and complete it also for issue at an early date. The model rules, Part 1, consist of eight sections, the first being a general section. The following sections deal with rules for the design and operation of plant with fire and explosive risks, for plant involving risks from gas, vapour, fume or dust, for plant involving dangers from contact with corrosive or deleterious substances and for plant involving other risks. The last three sections deal with fire protection, first aid, and with welfare. The publication is a part of the services provided for by the Association for its members, but so much importance is attached to dissemination of safety information that the Association is prepared to supply copies to firms outside its own membership on special request.

Malaria-Therapy by Means of Infected Mosquitos

TREATMENT of general paralysis of the insane by means of induced malaria, commenced in 1917, has been adopted everywhere. In the early days of malaria therapy, the fever was induced by the injection of the infected blood of a malaria patient, and this is still occasionally done; but generally the fever is now transmitted through the bites of infected mosquitos. This has been rendered possible by the establishment of a 'mosquito farm' at the Horton Mental Hospital. Full details respecting this 'mosquito farm', and of the methods employed for breeding, infecting and transmission are given in a recently issued report by Lieut.-Colonel J. A. Sinton ("A Report on the Provision and Distribution of Infective Material for the Practice of Malaria-Therapy in England and Wales". *Reports on Pub. Health and Med. Subjects*, No. 84. London: H.M. Stationery Office. 6*d*. net). At Horton, in a special insectary, an indigenous species of mosquito, *Anopheles maculipennis*, var. *atroparvus*, is bred throughout the year, freshly hatched females are collected and are stored in cages in an outhouse, being allowed to feed on a rabbit at appropriate intervals. When required for transmission work, the insects are placed in a special hot room for 48 hours, and are then allowed to feed upon a suitable patient with malaria in the wards of the hospital. A special Madagascar strain of benign tertian malaria parasite, *P. vivax*, is that used. A batch of 100–200 mosquitos are allowed to feed on the selected case, the insects being placed in jars and applied to the thigh of the patient. When most of the mosquitos seem to have fed, the jars are removed and the insects are then released into a storage cage, which is kept in a hot room maintained at about 75° F., and are fed every second day on a rabbit. After 10 days or so, when parasites are found in the salivary glands of the insects, the mosquitos are ready for use for transmission; they remain active for about a month. For the transmission to a patient for the 'cure', about 15–20 infected insects are placed in jars, and are taken to the hospital where the patient is. The mosquitos are then given an opportunity of biting by applying the gauze-covered end of the feeding jar to the external surface of the patient's thigh.

Mining and Fuel Technology at Sheffield

THE University of Sheffield's report on research work carried out in the Departments of Mining and Fuel Technology during the session 1936–37, recently published, gives a particularly lucid summary of progress made in the work undertaken by those two Departments. Within the confines of its twenty pages it is not possible to include a comprehensive account of every phase of the research, nor to publish many of the valuable results obtained. Nevertheless it can be amplified by reference to the technical papers cited in the appendix or by direct appeal to the university authorities. The Department of Mining has been concerned chiefly with the problem of provision in advance of ventilating schemes for projected workings, and it is hoped to publish tables from which it will be possible to calculate roadway sizes required to provide adequate ventilation under varying conditions. Problems of deterioration in efficiency of high candle-power electric lamps, resistance of different types of trailing cables to mechanical damage, influence of design and material on chain coal-cutter picks and investigations into the nature and conditioning of washery water, have received careful consideration by the Department, and valuable data have been adduced in these connexions. The Department of Fuel Technology has been concerned during the period with the compilation of a revised method of classification of coal with the view of ultimate definition of the relationship between compositions and properties of different coals. This work has been facilitated by the discovery of differences in behaviour between the younger and older coals which afford a useful basis of classification of coals of varying geological age.

Earthquake of August 16

AN earthquake of 'destructive' intensity was recorded on seismographs in Great Britain in the early hours of Tuesday, August 16. The epicentre of the shock is calculated to be about 5,500 miles away, possibly in the plains of Central Asia. A message from the seismological station at Hamburg,

Germany, states that the primary waves arrived at $4^h\ 38^m\ 55^s$, and the secondary waves at $4^h\ 47^m\ 54^s$, giving the distance of the epicentre from Hamburg at 7,600 km. As the region of the supposed epicentre is sparsely populated, it will be some while before direct information is available.

The Science Museum: Recent Acquisitions

A large collection of astrolabes, portable sundials, clocks and other scientific instruments, mainly of the sixteenth and seventeenth centuries, has been presented to the Science Museum by Mr. W. E. Miller and has now been placed on exhibition. The astrolabes are particularly fine examples; they include a fifteenth-century specimen from Germany and a sixteenth-century Flemish instrument, probably by Arsenius, one of the leading makers of his era. Among the sundials are several unusually large and fine ivory tablet dials by well-known south German makers of the early seventeenth century, as well as an interesting series of pocket dials of various types, many of them indicating time on the old Italian system in which the day-and-night period was divided into twenty-four equal hours, starting from zero at sunset and counting from 1 up to 24. The clocks have small projections opposite the hour numbers on the dial, so that the time can be found by touch during the night.

The Night Sky in September

The sun crosses the celestial equator at the autumnal equinox (or First Point of Libra) on September 23 at 17^h U.T. The moon is full on September 9 at $20{\cdot}1^h$ and new on September 23 at $20{\cdot}6^h$. For a few days near full phase, the moon rises only 21–23 minutes later on successive evenings instead of the normal 50 minutes in these latitudes—hence the Harvest Moon. The moon occults two naked-eye stars during the month, namely: (1) δ Piscium (mag. 4·6) on September 11, when its reappearance from behind the moon's disk, as seen from Greenwich, takes place at $22^h\ 40{\cdot}6^m$ U.T. at position angle 238° from the north point; (2) ϵ Tauri (mag. 3·6) on September 15, the disappearance taking place at $22^h\ 32{\cdot}2^m$ at 131° and the reappearance at $23^h\ 07{\cdot}5^m$ at 211°. The respective times and position angles as seen from Edinburgh are $22^h\ 35{\cdot}4^m$ (118°) and $23^h\ 18{\cdot}9^m$ (224°). Lunar conjunctions with the planets occur as follows: with Jupiter on September 8 at 7^h; with Saturn on September 12 at 8^h; with Mars on September 22 at 14^h and with Venus on September 27 at 9^h. Mars, a morning star difficult to see, is in conjunction with Mercury on September 4 at 20^h and September 16 at 15^h; on September 5, Mars is near the first magnitude star Regulus. Jupiter is a bright object rather low in the night sky and southing at about 22^h in mid-September. The various phenomena of the satellites may be followed with the aid of the tables and diagram given on pp. 616–617 of the *Nautical Almanac* for 1938. The four bright inner satellites, visible with binoculars, are most closely grouped near the planet at $22^h\ 15^m$ on September 1, 7 (all eastwards), 8, 10 (one satellite occulted), 17 (the same satellite again occulted by Jupiter), 18, 25 and 26. Saturn, which is now visible throughout the night, souths at about $1^h\ 30^m$ in the middle of the month. The diameter of the minor axis of the ring system is about 8″. At 22^h on September 15, Arcturus is setting in the north-west; Aldebaran is rising in the north-east, preceded by the beautiful cluster of the Pleiades.

Announcements

Mr. R. W. Hamilton has been appointed to succeed Mr. E. T. Richmond as director of the Palestine Department of Antiquities. Mr. Hamilton has been acting director since the retirement of Mr. Richmond a year ago, and joined the staff of the Department as inspector in 1931 after experience with the British School of Archæology in Palestine.

In Nature of May 7, p. 823, concern was expressed over the geophysical observatory at Zi-Ka-Wei. A correspondent informs us that he has just received a parcel of seismograms from the observatory. Thus in spite of the troubled times around Shanghai, the observatory is apparently carrying on its work.

The Rockefeller Foundation has offered and the London County Council has accepted the sum of £2,500 for the assistance of psychiatric research at the Maudsley Hospital.

The twenty-fifth French Congress of Medicine will be held at Marseilles under the presidency of Prof. Olmer on September 26–28. Further information can be obtained from Prof. Roger, 66 Boulevard Notre-Dame, Marseilles.

The second International Spa Federation Congress will be held in Berlin during the second half of September and will consist of five sections devoted respectively to the economic, legal, medical, and technical aspects, and tourism and propaganda. Further information can be obtained from Reichsfremdenverkehrsbund, Potzdamer Platz 1, Berlin.

We have received a copy of "Spectrochemical Abstracts, 1933–1937", by F. Twyman (London: Adam Hilger, Ltd., 3*s*. 10*d*., including postage 4*s*.). This is a 52-page bibliography with abstracts of 228 papers on spectro-chemical analysis which have appeared in the period stated. The references to the literature are grouped in an author index, to which references are made in the subject-matter, which is conveniently divided into topics under materials. There is also a list of recent books on the subject. The work, which is bound in limp covers, will be welcomed in scientific and technical laboratories.

Referring to the letter by E. V. Newnham entitled "Effects of Floods in East Norfolk", published in Nature of August 6, p. 257, Dr. Margaret Jepps writes: "Late in July one still passed (at Horsey, Norfolk) suddenly from a green landscape in high summer dress to a wintry scene with bare hedges and leafless woods between the brown wastes where in places the frost yet appeared to lie, since there had been too little rain to wash away the salt left by the receding seas."

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 400.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Capture Cross-sections for 220 Kev. Neutrons

THE selectivities (in Z) observed in the activation of nuclei by capture of slow neutrons are explained by differences of the energy (E) of the lowest neutron resonance level in different nuclei: the contribution of one level to the capture cross-section for thermal neutrons is proportional to $1/E^2$, while the cross-section at resonance is proportional to $1/\sqrt{E}$; the measured values of E lie between 1 and 200 volts. The application of the one-level formula[1,2] to the experimental results yields some evidence on the neutron width Γ_n and the radiation width Γ_γ of the best-known resonance levels. Some experimental evidence on the total widths has also been obtained[3,4,5].

Little or no direct evidence exists concerning the distance of the neutron levels for the excitation energies given by the mass defect of the captured neutron. The kinetic energies for which slow neutrons are selectively captured should lie between 0 and the distance of the levels. Statistical considerations seem to be scarcely applicable, since of course the lowest resonance energies are the easiest to observe and in the case of some nuclei the capture cross-section of which is very small and where no pronounced level has been found yet, the first resonance level for slow neutron capture may be situated rather high. Bethe and Placzek[2] have suggested the study of neutron capture under special conditions: for a neutron source emitting a spectral band broad enough to cover several resonance levels and the lower energy limit of which is high compared with the level distance, they derive the cross-section formula

$$\sigma = \pi^2\lambda\!\!\!^{-2} \cdot \frac{\Gamma_n\Gamma_\gamma}{(\Gamma_n + \Gamma_\gamma)D},$$

D being the averaged distance between levels and $\lambda\!\!\!^{-}$ the wave-length of the neutrons divided by 2π. This formula is obtained by summing the one-level formula over an interval containing many levels. The factor $\frac{\Gamma_n\Gamma_\gamma}{(\Gamma_n+\Gamma_\gamma)D}$ tends to become 1 when $\lambda\!\!\!^{-}$ becomes comparable with the distances existing between single particles within the capturing nucleus, that is for neutron energies of some million electron volts; for lower energies the factor would in any event be smaller than 1. On the basis of the nuclear compound model one should expect it to be of the same order of magnitude for nuclei of similar mass and for equal excitation energy.

Activations with high-energy neutron beams considered free of slow neutrons have already been carried through with D + D neutrons of some 2·5 Mev[6,7]. We made some measurements with a source of photo-neutrons produced by the γ-rays of thorium C″ in heavy water. This source gives neutrons of an average energy of 220 Kev. which in consequence of the conservation of momentum are distributed on a 40 Kev.-wide band. The source (5 c.c. D_2O with the γ-ray source in the centre, suspended far away from diffusing walls) was surrounded by cylinders of the elements investigated. Only nuclei for which a neutron-capture period is known were resorted to; the activities were measured by means of a Geiger-Müller counter which fitted inside the cylinders. In order to obtain the absolute cross-sections, the number of neutrons emitted by the source was determined after the method of Amaldi and Fermi[3,8]. A determination of the thickness responsible for the emission of one half of the observed β-rays was also carried through. The following cross-sections were obtained:

	^{27}Al	^{51}V	^{55}Mn	^{58}Ni	^{63}Cu	^{75}As	Se	^{79}Br	^{81}Br	^{109}Pd
σ (in 10^{-28} cm.^{2})	3	9	9	<9	$\simeq 9$	83	<3	160	<30	250

	^{107}Ag	^{109}Ag	^{121}Sb	Te	^{127}I	^{138}Ba	^{164}Dy	W	^{197}Au	Tl
σ	300	460	110	<10	175	<2	<70	26	230	$\simeq 10$

The factor $\Gamma_n\Gamma_\gamma/\{(\Gamma_n+\Gamma_\gamma)D\}$ being equal to σ divided by $\pi\lambda\!\!\!^{-2} = 0{\cdot}94 \times 10^{-28}$ cm.^{2}, its values in 10^{-2} units are represented by approximately the same numbers.

The results show considerable variations even for neighbouring nuclei, the nuclei showing biggest cross-sections being identical with those showing big cross-sections for *slow* neutron capture. A careful search was therefore carried through in order to make sure that the source does not produce slow neutrons, which might account for the observed selectivities in Z. Any influence of outside diffusing substances such as the floor could be excluded; in order to avoid the slowing down of neutrons, the cylinders were never touched by hand during activation. A process of slowing down by collisions in the heavy water could be ruled out, since additivity was observed when smaller amounts of heavy water were used instead of the total 5 c.c. The influence of (unknown) γ-rays of meso-thorium producing slower neutrons could be excluded by neutron absorption measurements in silver, using a silver detector.

The observed differences in the capture cross-sections are, therefore, real unless we assume the existence of a hitherto unknown isomer (difficult to observe because its period is too long or too short) in each case of seemingly low cross-section.

The coincidence that the same compound nuclei which show pronounced resonance levels at very slow neutron energies, show the big values for $\frac{\Gamma_n\Gamma_\gamma}{(\Gamma_n+\Gamma_\gamma)D}$ observed here, would imply the fact that the average distance of levels at the excitation energy given by the mass defect of the neutron is especially low for these nuclei. The table shows also that the nuclei with big capture cross-sections have mostly odd proton numbers and even neutron numbers.

A detailed account of these results will appear soon in the *Journal de Physique*. We are indebted to Dr. G. Placzek for many valuable discussions.

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[1] Breit and Wigner, *Phys. Rev.*, **49**, 519 (1936).
[2] Bethe and Placzek, *Phys. Rev.*, **51**, 450 (1937).
[3] Amaldi and Fermi, *Phys. Rev.*, **50**, 899 (1936).
[4] von Halban and Preiswerk, *J. de Phys. et Rad.*, **8**, 29 (1937).
[5] von Halban and Paxton, NATURE, **141**, 116 (1938).
[6] Booth and Hurst, *Proc. Roy. Soc.*, A, **161**, 248 (1937).
[7] Reddeman, *Naturwiss.*, **26**, 124 (1938).
[8] Amaldi, Hafstad and Tuve, *Phys. Rev.*, **51**, 896 (1937).

Hyperfine Structure Perturbations in Iodine due to Nuclear Quadrupole Moment

MURAKAWA[1] has recently published a more extended multiplet classification of the lines of the first spark spectrum of iodine, which differs in a number of respects from that given by Lacroute[2], and used by me in analysing the hyperfine structures. The line multiplets which have been arranged are in both cases similar, but the term allocations differ. Since, however, Murakawa retains almost all the J values found by Lacroute, the hyperfine structure analysis is only affected in the very few cases where the proposed J values are not in agreement.

The evidence from hyperfine structure strongly favours the classification of Murakawa. For example, the identification of the sp^5 levels removes the anomaly which was previously reported[3] for the interval factor of the term given by Lacroute as $(^4S)5d\ ^3D_3$. Also the hyperfine structures of the newly classified lines, where known, fit perfectly into the analysis now given. Further, a number of minor difficulties encountered in a recent more detailed analysis of the hyperfine structures[4] are removed by the use of the new classification.

From Murakawa's results the classifications are now known for a number of lines the hyperfine structures of which I have already measured. From these, ten new interval factors have now been derived, the details of which will be given elsewhere. A very exact analysis has been made from which it is evident that at least seven terms exhibit perturbation, the interval rule breaking down. The frequency of this indicates that it must arise from the existence of a nuclear quadrupole moment. However, the interaction energy for each perturbed level does *not* obey the $\cos^2$ law found to hold in other cases by Schüler[5]. Instead a cubic law is necessary to account for the observations. This can be written as

$$E = a_0 + \frac{a}{2} . C + b.C.(C + 1) + c.C^2.(C + 1),$$

where

$$C = F(F + 1) - I(I + 1) - J(J + 1).$$

The perturbation constants for the eight terms not obeying the interval rule are shown in the following table. (The units are cm.$^{-1} \times 10^{-3}$.)

For terms with $J = 1$ the constant c is arbitrary and has no precise meaning since there are only three fine structure levels which can always be adjusted to fit an equation with three constants.

The ratio of c to b is so high that the contribution of the cubic term becomes of great importance. This cubic term appears to be too large to be accounted for by assuming it to be a second order term in the accepted theory of quadrupole moment perturbation.

Term	a_0	a	b	c
(^3D) 6s $^3D_3$	502	65·5	− 0·44	− 0·015
(^3D) 6p $^3F_4$	345	41	− 0·19	+ 0·009
(^3D) 6s $^1D_2$	454	72	+ 0·11	− 0·012
(^4S) 5s 5p^5 $^3P_2$	1030	≈ 152	≈ + 0·2	—
(^4S) 5s 5p^5 $^3P_1$	600·5	176·1	+ 0·38	
(^3D) 6p $^3D_1$	344·8	107·1	+ 0·72	
(^3D) 6p $^1P_1$	100·8	18·4	− 0·87	
(^4S) 5d $^5D_1$	159·3	40·8	− 0·39	

If this is indeed the case, then the constant c must involve some nuclear physical property other than electrical quadrupole moment. There is strong evidence for assuming that the effect is due to a new phenomenon, namely nuclear *magnetic* quadrupole moment.

A detailed report will appear elsewhere.

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July 4.

[1] Murakawa, K., *Z. Phys.*, **109**, 162 (1938).
[2] Lacroute, P., Thesis, Univ. Paris (Nov. 1934).
[3] Tolansky, S., *Proc. Phys. Soc.*, **48**, 49 (1935).
[4] Tolansky, S., and Forester, G. O., in the Press.
[5] Schüler, H., and Schmidt, H., *Z. Phys.*, **89**, 239 (1935).

Quantum Theory and Relativity

STARTING from the assumption that the possibilities of defining and measuring high relative impulses are limited in a new way, because of the nature of β-ray forces (with participation of neutrinos) and because of the appearance of explosion showers in the high-energy collisions, an attempt is made to solve the convergence difficulties of quantum theory. The proposed solution is based on a new kind of algebra of quantum states and observables, and on the assumption of the existence of a new kind of indetermination arising from the interaction of high-energy particles with the measuring apparatus.

In every measurement there is always a part of the measuring apparatus which constitutes the reference frame. So, for example, in the γ-ray microscope, it is the diaphragm which limits the angular aperture and produces the characteristic diffraction phenomena. Considering all observables referred to such a reference frame, we assume that the new phenomena responsible for the supplementary indeterminacy in the region of high relative impulses have a universal character, that is, they appear in the collision of all kinds of particles. The assumptions referring to this indetermination can be formulated in the following manner. Let us consider an assembly of particles in a *Hohlraum*, and adopt as basic states the eigenstates of the momenta. From the point of view of the present quantum theory, the number of states in the interval $(p, p + dp)$ is given asymptotically by $dz = \frac{8\pi}{c^3} V p^2 dp$. In this formula we introduce a converging factor $G(p)$ in such a way that the number of new quantum states which can

be defined relatively to the *Hohlraum* is: $dz^1 = \frac{8\pi}{c^3} V.G(p)\,p^2\,dp$, where $G(p) \sim 1$ if $p < b$, and $G(p) \to 0$ if $p \to \infty$, and $b = h/r_0$ is a critical value of the impulse. It means that a Lorentz observer has no possibility of distinguishing between states belonging to an assembly of $n(p) = G^1(p)$ neighbouring states. (A discussion of the measure of p by means of the Compton effect shows that the possibilities offered by this measure are not incompatible with the existence of the indeterminacy here examined.) For example, if a particle with $p > b$ produces showers by collision with the walls, the usual eigenstates become energetically connected and consequently indistinguishable. Considering the correlation between the quantum states and the cells of volume h^3 in the phase-space, we can say that it is impossible to distinguish experimentally elements of an assembly of $n(p)$ neighbouring cells, and thus it is necessary to consider such an assembly as constituting a unique quantum cell in the new theory. We assume, therefore, that the observables, impulse p_x and co-ordinate x, relative to a reference frame individualized by the measuring apparatus, satisfy the commutation relation of the type:

$$\Delta p_x \, \Delta x \gtrsim h \cdot f(p_x),$$

where $f(p_x) \sim 1$ if $|p_x| < b$ and $f(p_x) \to \infty$ if $|p_x| \to \infty$.

Recently I have shown that it is possible to build an example of representatives of these new states and observables satisfying the following rules: the number of states for a unit impulse interval has a maximum for $p \sim b$; the total number of states is finite; the representatives of the states corresponding to the impulse-operator are not orthogonal; the orthogonality is approximately satisfied only for eigen values $p < b$.

In order to satisfy the claim of relativistic invariance, it is possible to substitute systematically for the impulses the modulus of the difference between two 4-vectors p_r referred to an initial and a final state respectively. The consideration of the reference frame individualized by the measuring apparatus in this formulation of the theory gives results of great importance.

The most important consequences of the modified algebra of states and observables will be discussed in detail elsewhere. Let us confine ourselves to some remarks regarding the possible origin of Heisenberg's explosion-showers. According to the present quantum theory, the simultaneous production of many particles in a single quantum process is very improbable because it corresponds to a high-order process of the perturbation theory. In a first order transition the selection rules, derived in the case of photons from the orthogonality and peculiar properties of the eigenfunctions of a harmonic oscillator, forbid transitions with emission and absorption of more than one photon. The representatives of the new quantum states corresponding to $p > b$ are not orthogonal and differ sensibly from the usual representatives. Therefore the first order process with simultaneous emission of many particles becomes probable, with the same order of probability as the single particle transition.

A more detailed discussion shows that in the barycentric frame of two colliding particles the impulses of secondaries have their probable values $\sim b$ because the great majority of quantum states is condensed in the region $p \sim b$. In another reference frame, in which the barycentre is moving with an ultra-relativistic velocity, nearly all secondaries are projected, with $p \gg b$, within a small solid angle (as in the hard showers of Bothe). The existence of a lower limit of measurable lengths follows also from the assumption discussed above.

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Indeterminacy and Electron Spin

SINCE a dipole of magnetic moment M in a magnetic field of intensity H has a potential energy $-M.H$, two free electrons in magnetized iron with magnetic axes respectively parallel and anti-parallel to the direction of magnetization should differ in potential energy by $Heh/2\pi mc$, where H is the effective field intensity acting on a free electron in the iron. It may be of some interest to see whether this difference in energy could be detected in an ideal experiment, for example, by a splitting under magnetization of the photo-electric threshold of iron, or whether the quantum indeterminacy prevents the resolution, as Bohr has shown it must in a Stern-Gerlach experiment on a beam of free electrons[1].

Let the field be assumed parallel to a boundary of the iron. At the photo-electric threshold those electrons will just escape which reach the boundary with a velocity v normal to the surface, the work function being given by

$$W = \tfrac{1}{2} mv^2.$$

The path of these electrons in the iron will be an arc in a plane normal to the direction of magnetization and having a radius given by

$$\rho = mvc/He.$$

They must therefore have received the kinetic energy W at some point on a semi-circle in the iron, and their initial angular position is thus determined within the angle π. Canonically conjugate with the angular co-ordinate is the angular momentum given by

$$mv\rho = m^2v^2c/eH = W \cdot 2mc/eH.$$

The indeterminacy in the angular co-ordinate being π, we have:

$$\pi \cdot \Delta(mv\rho) \geqslant h$$

whence

$$\Delta W \geqslant Heh/2\pi mc.$$

But this is just the difference in energy that was to be resolved, and the resolution is thus impossible.

If the direction of magnetization is normal to the boundary, the conclusion is the same. The argument in this case resembles that for the Stern-Gerlach experiment in that it depends on the divergence equation of the magnetic field.

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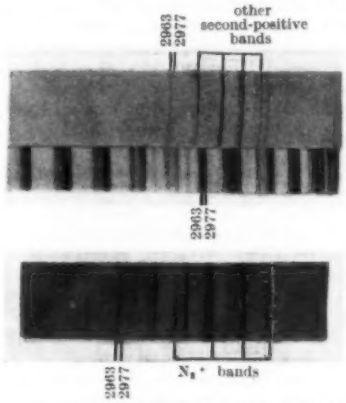
[1] See Mott, N. F., *Proc. Roy. Soc.*, A, **124**, 425 (1929).

Existence of the Bands 2963, 2977 in Night Sky Spectra

THE list of wave-lengths in the light of the night sky, which was reported by Gauzit[1] two years ago, includes the two second positive bands of nitrogen 2963 and 2977 with an intensity ratio of 2 to 1. Since those bands lie in the region of the great Hartley absorption band of ozone, the reality of those observations could readily be open to question. The importance of additional evidence concerning this problem is understood when it is pointed out that the shortest auroral radiation which has been reported is the second positive band at 3110.

If the 2963 band has really been observed by Gauzit, it would mean that this radiation originates lower in the atmosphere than most auroral displays. Recent afterglow pictures, taken at very high pressures, show these two bands and the remaining band of the sequence, with about the same relative intensity as that reported by Gauzit, and not at all like the intensity distribution in the electrical discharge in which 2977 is at least as intense as 2963. These are shown in the accompanying figure.



a, HIGH PRESSURE AFTERGLOW, ABOUT 20 MM.; *b*, DISCHARGE; *c*, MEDIUM PRESSURE AFTERGLOW, ABOUT 1 MM.

The successful reproduction of this unusual relative intensity in the afterglow gives additional evidence that the bands observed by Gauzit are real. In addition, one must conclude that the second positive bands in the night sky originate low in the atmosphere, otherwise it would have been impossible to observe them; and finally, one can conclude that the light of the night sky is really like the chemiluminescence which is responsible for the production of these afterglows.

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[1] J. Gauzit, *J. Phys. et Rad.*, **5**, 527 (1934).

An Anomalous Change in the Electric Resistance of Iron-Silicon Alloys with a Longitudinal Magnetic Field at Various Temperatures

THE electric resistance of Fe-Si alloys was measured in a longitudinal magnetic field at various temperatures. The specimens were annealed at 1000° C. for one hour and re-annealed at 850° for one hour after setting them on the measuring apparatus.

The relation between the changes in resistance and temperatures at a constant field of 1,500 oersteds for 1·66 per cent and 9·43 per cent silicon alloys was obtained as shown in the following table.

1·66 per cent silicon		9·43 per cent silicon	
t (° C.)	$R/R \times 10^3$	t (° C.)	$R/R \times 10^3$
− 195	− 0·055	− 195	− 0·135
− 95	− 0·025	− 95	− 0·133
10	0·010	10	− 0·103
100	0·040	100	− 0·076
201	0·075	200	− 0·059
300	0·075	300	− 0·024
402	0·070	401	− 0·011
505	0·065	499	0·001
592	0·048	599	− 0·010
703	0·019	643	− 0·050
745	− 0·022	650	− 0·080
776	− 0·116	660	− 0·142
789	− 0·177	670	− 0·029
801	− 0·020	690	− 0·010
820	0·000	720	− 0·003

From this table, we see that the resistance decreases with the longitudinal magnetic field at temperatures other than in the vicinity of the Curie point, which phenomenon was not observed in the alloys of Ni-Cu[1], Ni-Co[2] and Fe-Ni[3] previously investigated. The decrease of resistance in solid solution alloys is a very interesting fact, which has not heretofore been observed by investigators. This phenomenon has been also observed in Fe-Al alloys. The complete report of the present investigation will shortly be made in the Science Reports of the Tôhoku Imperial University.

In conclusion, I wish to express my cordial thanks to Prof. K. Honda, president of the Tôhoku Imperial University, and to Prof. H. Masumoto, under whose kind guidance the present investigation has been carried out.

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[1] Masumoto, H., and Shirakawa, Y., *Sci. Rep. Tôhoku Imp. Univ.*, **25**, 104 (1936).
[2] Shirakawa, Y., *Sci. Rep. Tôhoku Imp. Univ.*, Honda Anniv. vol., 362 (1936).
[3] In the Press.

Gamma to Alpha Transformation in Iron Alloyed with Palladium

THE gamma to alpha transformation of iron is of fundamental importance in the heat treatment of steels. The face-centred-cubic gamma form, stable at high temperatures, transforms so rapidly to the body-centred-cubic alpha form below 906° C. that it cannot be preserved by quenching. Various alloying elements stabilize the gamma phase so that it may be obtained at room temperature as a stable or metastable form.

Carbon is of predominating importance among these elements. It is soluble to a considerable extent in gamma iron, being dissolved interstitially, but is almost insoluble in alpha iron. Consequently, austenite (gamma iron containing dissolved carbon) tends to decompose below the transformation temperature into alpha iron plus a carbon-rich phase which is cementite, Fe_3C, or graphite. For low carbon contents, this reaction takes place too rapidly to

follow, but above 0·7 weight per cent carbon (3·2 atomic per cent), it may be arrested by a sufficiently rapid quench. Quenched samples are found to consist of austenite plus martensite.

Martensite is considered to be an intermediate phase in the decomposition of austenite into alpha iron plus cementite at sub-critical temperatures. It is body-centred, like alpha iron, but the cubic symmetry is distorted into tetragonal by lengthening of the c axis. The c/a ratio decreases linearly with decreasing carbon content. If this trend is extrapolated, c/a would apparently be close to one at zero per cent carbon. Thus, martensite resembles a supersaturated solution of carbon in alpha iron, with the symmetry distorted by the carbon.

This suggests that with a suitable quench the first step in the decomposition of austenite is a rearrangement of atoms into a body-centred form. Further annealing will result in the expulsion of carbon in a carbon-rich phase. Although a large number of papers have been written on this subject, the mechanism of this transformation is still disputed.

In an X-ray examination of the iron-palladium system, we found an intermediate stage in the decomposition of the gamma form which resembles martensite in several respects.

Palladium, which is miscible in all proportions with gamma iron, is only slightly soluble in alpha iron. There is a wide two-phase region between alpha and gamma extending at low temperatures from 1 or 2 atomic per cent palladium to about 42 atomic per cent.

However, samples containing 5·5, 10 and 20 atomic per cent palladium showed only a single body-centred-cubic phase when quenched from the gamma range. The lattice constants of this phase increased linearly with the palladium content, as shown in the accompanying table. Since all the lattice constants are greater than that of a saturated solution of palladium in alpha iron, it is assumed that the palladium is in supersaturated solution.

LATTICE CONSTANTS OF SUPERSATURATED SOLUTIONS OF PALLADIUM IN ALPHA IRON.

Atomic per cent palladium	Lattice constant
0	2·86
Saturated at 740° C.	2·87
5·5	2·89
10·0	2·91
20·0	2·96

Hence, under the quenching conditions, the decomposition of the gamma phase takes place in at least two steps. First, the atoms rearrange themselves into a body-centred form, then palladium is precipitated out in a face-centred palladium-rich phase.

The resemblance to martensite is obvious, but there are several differences which should be noted. First, palladium is dissolved in a substitutional rather than an interstitial solid solution. Second, only one phase is present in the quenched sample, while in the iron-carbon system austenite accompanies martensite. Third, the intermediate phase is cubic, rather than tetragonal.

The quench by which the intermediate phase is obtained need not be drastic. Lines are fairly sharp, except for those near back-reflection, which are diffuse. Two other samples, containing 34·4 and 39·5 atomic per cent palladium, respectively, retained the gamma phase on quenching.

We expect to publish our work on the complete iron-palladium system later. We are indebted to Dr. A. B. Greninger and Mr. A. R. Troiano for illuminating discussions of the martensite problem.

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Adsorption Potentials and Ageing Liquids

Messrs. Craxford and Gatty and Lord Rothschild[1] have recently commented on our letter[2] on "oil-potentials", that is, the E.M.F. of cells of, for example, the type:

Calomel electrode	Electrolyte BA in water C_1	'Oil' (= water-immiscible organic liquid)	Electrolyte BA in water C_2	Calomel electrode

Everyone must admit that the processes in such an 'oil-cell' are very complicated. If we wish to understand them, we have to idealize in some way or other (which, of course, means a loss of exactness). Previous investigators have tried the ideal "Partition equilibrium at the interfaces, steady diffusion between them". Finding this theory inconsistent, we have suggested that another ideal, "Adsorption equilibrium, negligible diffusion", will in certain systems give a better qualitative and even quantitative agreement with facts.

Now Craxford, Gatty and Rothschild state that there must still be a certain diffusion of ions through the interfaces. This we have not denied. But we cannot understand their argument: "the cells examined by Ehrensvärd and Sillén take up definite potentials", they say, but if "the interphase contains a boundary across which no charged particle can pass", "it has no definite potential of its own". Now a palmitic acid monolayer between water and air should suit the above description, as it is very hard to imagine a diffusion of ions from water to air. But it still has a definite potential of its own, according to work of Rideal, Schulmann[3], *et al.*

Craxford, Gatty and Rothschild quote the well-known modernized form of Henderson's integral formula for diffusion potentials[4] and also give a few reasons why it is useless in this case. There are other reasons for this too. For example, we have to do not only with the two ions of the salt, but also with the ions of water and whatever charged particles may transport electricity inside the oil. The transport number, t_i, for each kind of charged particle will therefore be a hopelessly complicated function of the concentrations and mobilities of all sorts of particles present. Moreover, this function should be integrated.

Instead of leaving the question at that point, we have tried to find a practical method of attacking the problem. Especially we hope that the adsorption point of view will prove useful for understanding rapidly changing biological systems, where diffusion will have very little time to develop.

One complication we met in our experiments at first greatly confused us. There is a remarkable difference between the E.M.F's of a certain oil-cell, if the organic liquid is freshly distilled, and on the other hand if it has been kept in a glass bottle for some time after the last distillation (of course, the

cells are prepared in exactly the same way). After a few hours or days in the glass bottle, the process of 'ageing' seems to be terminated. After that, the oil will give the same E.M.F. in a certain cell whenever it is taken from the bottle. A difference is also found between newly prepared and aged oil-mixtures, for example, of nitrobenzene and benzene. Dr. Y. Björnståhl, Uppsala, has told us that he has found similar ageing effects with the magneto-optic properties of nitrobenzene and some other liquids.

What has happened inside the oil? Dr. F. C. Frank, of Oxford (at present of Berlin), has suggested to us that the ions of the glass may have slowly dissolved into it. We are rather inclined to think that it is a question of molecular re-association. We have read the long discussion of Baker, Smits[5] and others without being much wiser. If anyone could give us a hint, we should be grateful for any communication, public or private, as we have very little time left for a special investigation of this question. So far we have mostly studied 'old' liquids, as giving more constant values.

Our work is still proceeding. By experiments on the short-circuiting of oil-cells and cataphoresis of oil droplets, we are now investigating the diffusion rate and the surface charge of the interfaces. Until this work is completed we intend to publish no more about oil-potentials. But we shall be very glad to have personal communication with Messrs. Craxford and Gatty and Lord Rothschild.

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[1] Craxford, S. K., Gatty, O., and Lord Rothschild, NATURE, **141**, 1098 (1938).
[2] Ehrensvärd, G., and Sillén, L. G., NATURE, **141**, 788 (1938).
[3] Schulman, J. H., and Rideal, E. K., *Proc. Roy. Soc.*, **130**, 259 (1931).
[4] Henderson, P., *Z. phys. Chem.*, **59**, 118 (1907).
[5] Smits, A., *et. al.*, *Z. phys. Chem.*, **153**, 253, 255 (1931).

Mode of Action of Visual Purple

FOR the chemical theory of excitation of nerve cells, the following observations as to how the retinal rods are stimulated by the substance visual purple would seem to be of general interest. Their understanding requires knowledge of the fact that after a preceding period of adaptation to sunlight the size of the electrical response of the eye to a constant test light reproduces the curve of regeneration of visual purple (see, for example, [1,2,3]). When the quantity of visual purple, obtainable from an eye after increasingly longer periods of dark adaptation, increases, the size of the electrical response (its *b*-wave) likewise increases owing—one would have thought—directly to the larger amount of cell stimulant available.

Actually, however, parallel measurements of visual purple densities and size of the electrical response in dark-adapted excised frogs' eyes under strictly identical conditions show that, after 5–10 minutes of adaptation to the moderately strong monochromatic stimuli from a spectral source, the electrical response may be greatly reduced without any parallel diminution of the concentration of visual purple. With test lights from the short wave-lengths 0·500–0·430 μ, and adapting lights 0·450 and 0·580 or 0·560 μ, it is found that the long wave-lengths may cause a reduction of the electrical response by some 40–50 per cent and that, contrary to expectation, the short adapting wave-lengths have a much smaller effect on the response to the test light, sometimes even causing it to increase[4]. The total quantity of visual purple obtained from eyes in which the electrical response has been reduced by 1/3–1/4 by adaptation

DIAGRAM ILLUSTRATING OUTER LIMB OF ROD WITH ACTIVE STIMULATING VISUAL PURPLE (FILLED CIRCLES) AND INACTIVE NON-STIMULATING STORE OF VISUAL PURPLE INSIDE THE CELL.

(digitonin extracts tested photo-electrically) is neither influenced by the adapting wave-length used, nor is it reduced compared with the amount of visual purple of completely dark-adapted control eyes. Our technique of measuring the density of visual purple of single retinas gives averages identical to within 7 per cent. Therefore less than 7 per cent of the total visual purple is *active* in mediating maximal electrical responses in dark-adapted eyes. The rest is a store of photosensitive material which is *inactive* from the point of view of excitation of the cell. However, this store must be large in order to enable the eye to react maximally[1,2,3].

These facts are simply accounted for on the hypothesis (see the tentative scheme of the accompanying figure) that the active visual purple is active because of its particular manner of distribution, say, at the surface of the outer limb of the rod cell, but that a high concentration of the non-stimulating store of inactive material inside the cell is necessary for keeping up the charge at the surface. Illumination may then be assumed to lead to a depolarization of the surface spreading electrotonically and giving rise to the *b*-wave of the electrical response of the retina.

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[1] Tansley, *J. Physiol.*, **71**, 442 (1931).
[2] Charpentier, *Acta Ophthalm.* Kbh., Suppl. **9** (1936).
[3] Granit, "Processes of Adaptation in the Vertebrate Retina, etc.", *Documenta Ophthalmologica*, **1**, 1 (1938).
[4] Granit, Therman and Wrede, *Skand. Arch. Physiol.* (in the Press).

Synthesis of Growth Factors by *Rhizobium trifolii*

A STUDY of the growth factor requirements of *Rhizobium trifolii* has indicated that, under suitable conditions, the organisms are able to synthesize all the organic substances essential for growth from a synthetic carbohydrate - mineral salts medium of

known composition. Although various extracts of plants and micro-organisms contain a heat-stable factor *stimulative* to growth, it is not required for successful continuous transfer of the organism in synthetic media. A base medium, claimed by Allison and Hoover[1] to be incapable of supporting continued growth of the nodule organism in the absence of extracts of *Azotobacter* or other substances (termed 'coenzyme *R*'), was found to be satisfactory after adjusting the oxidation-reduction potential and adding iron. Although the growth was not profuse in comparison with media which contain plant extracts, continuous transfer was possible.

Further experimentation indicated that continuous transfer of *Rhizobium trifolii* in the purified base medium is dependent upon a highly active factor, synthesized by the growing culture and transferred in sufficient amount with a loop inoculum (0·005 ml.) to enable initiation of growth in the new medium. Inoculations made with cells removed from the medium in which they had grown, and washed free of the metabolic products, caused little or no growth in the synthetic modified medium, whereas those not so treated grew well. This separation of the cells from their essential factor can be accomplished by aseptic centrifugation of a fluid culture or by mere suspension of a small amount of growth from an agar slope in fresh medium. Addition of so little as 0·01 per cent filtrate from a culture of *Rhizobium* (grown in the synthetic medium) or the autolysate of a culture permits 'washed' inocula to grow normally.

From various chemical and biological properties, to be described in detail elsewhere, two components of the *Rhizobium* factor have been identified as vitamin B_1 (thiamin) and riboflavin, which occur in the culture autolysates as heat-labile complexes. A method developed by West and Wilson[2] for the determination of vitamin B_1 has indicated that *Rhizobium trifolii* synthesizes 19·6 micrograms of vitamin B_1 per gm., an amount closely approximating that found in yeasts. Moreover, analyses for riboflavin likewise reveal a high content (0·3 microgram per milligram) of this vitamin. Although these substances are more active in combination, either one alone is capable of replacing the activity of the culture filtrate. Both thiamin and flavin, but especially the latter, have a very narrow range of activity; slight increases in concentration beyond the optimum result in lessened stimulation.

As previously pointed out by Laird and West[3], when inocula carrying metabolic products from the previous culture are employed, only a slight stimulation of growth is to be observed in the presence of thiamin. Later studies have shown the same to be true of riboflavin. In view of the recent report by Nilsson *et al.*[4] concerning stimulation of *Rhizobium* by thiamin, it was considered desirable to summarize the data obtained in these laboratories concerning the role of the B vitamins and other growth factors in the nutrition of the nodule bacteria.

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[1] Allison, F. E., and Hoover, S. R., *J. Bact.*, **27**, 561 (1934).
[2] West, P. M., and Wilson, P. W., *Science*, in the Press.
[3] Laird, D. G., and West, P. M., *Canad. J. Res.*, in the Press.
[4] Nilsson, R., Bjälfve, G., and Burström, D., *Naturwiss.*, **13**, 284 (1938).

Inhibition of Adventitious Bud Initiation in Hypocotyls of Flax by Indole-3-Acetic Acid and Flax Extract

HYPOCOTYLS of intact flax plants (*Linum usitatissimum* L.) rarely develop buds. If decapitated, the young hypocotyl initiates adventitious buds some of which develop into flowering shoots[1]. The result is the same if both the cotyledonary buds and the epicotyl are removed, but the cotyledons are allowed to remain. Hypocotyls of plants with cotyledons and the young epicotyl enclosed in a plaster cast remain budless. Segments of hypocotyls[2] and of internodes occasionally initiate buds. These findings suggested that bud initiation is under hormonal control which is disturbed by partial or complete isolation.

Since each hypocotyledonary bud is initiated by division of a single epidermal cell[3] without immediately precedent enlargement, these findings suggested flax for study of the influence of its auxins and of indole-3-acetic acid upon the sequence of the cellular events which initiates an hypocotyledonary bud in flax.

Ether extracts of upper portions of plants severed in the hypocotyl were mixed in equal parts by weight with lanolin and applied daily for a week to cut surfaces of hypocotyls. Hypocotyls, cut and (*a*) treated and (*b*) not treated with lanolin, served as controls. Concurrently hypocotyls were treated with applications of indole-3-acetic acid in lanolin in concentrations ranging from 3 to 0·000056 per cent. The flax extract significantly decreased both rate and frequency of bud initiation. Indole-3-acetic acid in concentrations ranging from $1·7 \times 10^{-2}$ to $7·5 \times 10^{-4}$ molar completely inhibited bud initiation but induced apical tumours, while the other concentrations, ranging from $3·7 \times 10^{-4}$ to $2·7 \times 10^{-4}$ molar, retarded and diminished it with progressively decreasing tumour formation. Because of variability of material and growing conditions we have not been able to determine the end-point of deleterious effect for indole-3-acetic acid, or whether the lowest concentrations used ($5·5 \times 10^{-6}$ and $2·7 \times 10^{-6}$ molar) favour bud initiation as reported by Greenleaf[4], Beal[5] and Goldberg[6] for high concentrations when applied to tobacco, lily and cabbage.

Our findings add inhibition of hypocotyledonary bud formation to the long list of secondary effects produced in plants by native auxins (autoauxins) and by indole-3-acetic acid (one of the heteroauxins). Since in flax this bud formation is initiated by cell divisions which are not immediately preceded by cell enlargement, the results suggest that a cell-division substance (possibly a complex of substances) is a constituent of the causal complex which brings about these bud-initiating cell divisions. Probably these or other cell-division substances play their part in initiation and maintenance of the other meristems. Laibach's[7] term 'meristins' is suggested for this type of cytomerisone[8], which appears distinct from traumatin[9] and other wound hormones.

Went[10,11] has advanced a hypothesis of specific growth substances additional to auxins. In terms of this hypothesis the results here reported, in conjunction with those of others, indicate that auxin gradients influence meristins in such manner that the latter become effective in regions of relatively high auxin concentrations. In addition to influencing the transport and activity of meristins, auxins, through their influence on cell metabolism, also are factors in the production of cell-division substances. If

it should develop that the substance (or substance complex) which initiates the cell divisions of a bud meristem and of its products (growing point and leaf primordia) is not only a cell-division substance but also specifically a bud-forming substance, then it should be designated blastocaline to distinguish it from Went's rhizocaline[11], which forms roots. If a specific meristin is involved in leaf-bud and another in flower-bud initiation, then a more specific term will have to be used for each.

Conceivably the substances which specifically affect or effect the basic growth events of cells—increase in protoplasm, cell size, cell number and cell complexity—are regulated in each plant by other specific substances in such manner that the various kinds of cells, tissues and organs of the plant are initiated and developed. If this proves to be the situation, then the division substance indicated by our experiments cannot be designated blastocaline. Probably internal factors other than specific chemical agents are also decisive factors in conditioning the kind, place, moment, intensity and duration of the basic growth events of cells in such manner that the specific cells, tissues and organs of each plant are initiated and developed.

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[1] Reichardt, H. W., "Beiträge zur Kenntniss hypokotylischer Adventivknospen und Wurzelsprosse bei krautigen Dikotylen." Wien, 1857.
[2] Neubert, H., "Ersatzbildung beim Flachs", *Faserforschung*, **9**, 9–63, (1931).
[3] Crooks, D. M., "Histological and Regenerative Studies of the Flax Seedling", *Bot. Gaz.*, **95**, 209–239 (1933).
[4] Greenleaf, W. H., "Induction of Polyploidy in Nicotiana", *Science*, N.S., **86**, 565–566 (1937).
[5] Beal, J. M., "Bud Development in *Lilium harrisii* following Treatment with Indole-Acetic Acid", *Proc. Nat. Acad. Sci.*, **23**, 304–306 (1937).
[6] Goldberg, E., "Root and Shoot Production induced in Cabbage by *beta*-3 Indole-Acetic Acid", *Science*, N.S., **87**, 511–512 (1938).
[7] Laibach, F., Mai, G., and Müller, A., "Über ein Zellteilungs-Hormon." *Naturwiss.*, **22**, 288 (1934).
[8] Link, G. K. K., Wilcox, H. W., and Link, A. DeS., "Responses of Bean and Tomato to *Phytomonas tumefaciens*, *P. tumefaciens* Extracts, *beta*-Indoleacetic acid, and Wounding", *Bot. Gaz.*, **98**, 816–867 (1937).
[9] Bonner, J., and English, J., "A Chemical and Physiological Study of Traumatin, a Plant Wound Hormone", *Plant Physiol.*, **13**, 331–347 (1938).
[10] Went, F. W., "Allgemeine Betrachtungen über das Auxin-Problem", *Biol. Zentblatt.*, **56**, 449–463 (1936).
[11] Went, F. W., "Specific Factors other than Auxin affecting Growth and Root Formation", *Plant Physiol.*, **13**, 55–81 (1938).

A Simple Conversion of *Trans*-Dehydro-Androsterone into Pregnane Derivatives

ABOUT a year ago, we published a method whereby it was possible to carry out a practically quantitative addition of acetylene to *trans*-dehydro-androsterone[1]. We have in the meantime ascertained that the thereby easily obtained 17-ethinyl-3-*trans*,17-dioxy-androstene-(5), [*A*], in glacial acetic acid in the presence of acetic anhydride and mercuric oxide together with the boro fluoride-ether catalyst[2] readily adds on acetic acid to the triple bond and gives rise to 20-acetoxy-3-*trans*,17-dioxy-pregnadiene-(5, 20), [*B*], m.p. 175–177° (corr.); CH-determinations agree with $C_{23}H_{34}O_4$. The 3-monoacetate of [*A*] also adds on acetic acid with the formation of 3-*trans*, 20-diacetoxy-17-oxy-pregnadiene-(5,20), [*C*], m.p. 191–192° (corr.); CH-determinations agree with $C_{25}H_{36}O_5$.

By alkaline hydrolysis of [*B*] or [*C*] 3-*trans*,17-dioxy-pregnen-(5)-one-(20) is formed in good yield m.p. 275–277° (corr.), $[\alpha]_D - 78°$ (dioxan); CH-determinations agree with $C_{21}H_{32}O_3$; oxime m.p. 245–247° (corr.), CH- and N-determinations agree with $C_{21}H_{33}O_3N$; 3-monoacetate, prepared by treatment with acetic anhydride and pyridine in the cold, m.p. 270–272° (corr.), CH-determinations agree with $C_{23}H_{34}O_4$.

Further conversion products of these new compounds, specially the preparation of 17-oxy-progesterone and certain compounds in the corticosterone series[3], will be described later.

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[1] Ruzicka, L., and Hofmann, K., *Helv. chim. Acta*, **20**, 1280 (1937).
[2] Hennion, G. F., Hinton, H. D., and Nieuwland, J. A., *J. Amer. Chem. Soc.*, **55**, 2858 (1933).
[3] In collaboration with Prof. Reichstein.

Use of Amino-Acids containing Deuterium to follow Protein Production in the Organism

WHEN α-amino-acids are heated to 100–170° with heavy water and strong acids or bases, heavy hydrogen (D) is introduced in a stable or practically stable position in the amino-acid molecule[1,2]. The position into which D is introduced seems to be the C–H linkage at the α-C atom; and further into the ring of some of the aromatic and the heterocyclic amino-acids.

It was suggested[2] that amino-acids prepared in this way could be used to follow the fate of amino-acids in the organism. The following experiment was made. A rat, starved for 48 hours, was given a food consisting of equal parts of dried milk, whole rye flour and butter. For every gram of protein was added 0·5 gm. casein hydrolysate containing heavy hydrogen (dry, and practically free from inorganic ions). This food was given for three days. In all, 3·5 gm. protein and 1·75 gm. hydrolysate was eaten by the rat. Then the animal was killed (weight 150 gm.) and single organs dried and extracted with acetone and petrol ether. The casein hydrolysate used was prepared by heating 3 gm. casein with 14 c.c. 50 per cent deuterium and 3 c.c. sulphuric acid (conc.) in a sealed pyrex tube to 170° for 24 hours. Sulphuric acid was removed quantitatively, the water distilled off and the residue dissolved in ordinary water and dried again twice to remove the non-stable deuterium. By complete ignition, this hydrolysate would give water containing 6 per cent D_2O. The combined food-protein and hydrolysate would give an amino-acid mixture yielding water containing 2 per cent D_2O. Assuming that only the *l*-series of amino-acids could be used by the organism for building up protein (the hydrolysate being a racemic mixture of both series), the concentration of D_2O formed by ignition of newly formed protein would be at most 1 per cent, and in reality somewhat lower on account of the differences as regards the relative amounts of the amino-acids in the food and the organs of the rat.

On determining the D_2O content of combustion water from liver protein, 0·1 per cent D_2O was found, which means that at least 10 per cent of the liver protein present after the experiment is newly formed from the food absorbed in the course of the three days of experimental feeding. In the muscle the concentration of deuterium was less, indicating that about 2·5 per cent of the protein was newly formed.

The water distilled off from the organs showed a D_2O concentration of 30 mgm. per cent, which shows that most of the ingested protein has been broken down in the organism. This experiment supports the well-known view that the liver functions as a protein depot[3], but experiments have to be done under varied conditions before definitive conclusions can be drawn.

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July 4.

[1] Günther, G., Diss. Leipzig (1937).
[2] Krogh, A., and Ussing, H. H., *C. R. Lab. Carlsberg*, Ser. chim., **22**, 282–287 (1938).
[3] Addis, T., Poo, L. J., and Lew, W., *J. Biol. Chem.*, **115**, 11, 117 (1936).

Chemical Studies on the Adreno-Genital Syndrome

IN a recent issue of the *Journal of Biological Chemistry* we published a paper[1] entitled "Chemical Studies on the Adreno-Genital Syndrome. (1) The isolation of 3(α)-hydroxyetiocholane-17-one, 3(β)-hydroxyetioallocholane-17-one (isoandrosterone), and a new triol from the urine of a woman with an adrenal tumor".

We wish to take this early opportunity of pointing out that the word 'hyperplasia' should be substituted for the word 'tumor' in this title. The mistake arose as a result of a slight misunderstanding in our correspondence with Mr. L. R. Broster, of the Charing Cross Hospital, who very kindly supplied us with the urine upon which these researches were carried out. We wish to add that this unfortunate misunderstanding arose entirely from an oversight on our part, and was in no way the fault of Mr. Broster.

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July 12.

[1] *J. Biol. Chem.*, **124**, 237 (1938).

Points from Foregoing Letters

A TABLE giving the capture cross-section for 220 Kev. electrons, by various elements, is submitted by Dr. H. von Halban, jun., and Dr. L. Kowarski. It shows that the nuclei with big capture cross-sections have mostly odd proton numbers and even neutron numbers.

Seven out of ten interval factors, calculated by Dr. S. Tolansky from the hyperfine structure of the iodine spark spectrum, show perturbations which indicate the existence of a nuclear quadrupole moment. The interaction energy for each perturbed level necessitates a cubic law to account for the observed values.

Prof. G. Wataghin makes an attempt to solve the convergence difficulties of the quantum theory and to explain the explosion-showers, starting from the assumption that our ability to measure high relative impulses is limited in a new way. A new algebra of states and observables which corresponds to a supplementary indetermination (due to β-ray forces, neutrinos, showers) by the high-energy collisions is discussed.

Prof. R. T. Cox and Prof. F. E. Myers consider that the quantum indeterminacy would prevent the observation of the difference in potential energy between the two free electrons in magnetized iron, which have magnetic axes respectively parallel and anti-parallel to the direction of magnetization.

Prof. J. Kaplan gives laboratory evidence supporting the reality of the observation by Gauzit of the second positive bands of nitrogen, 2963, 2977, in the light of the night sky. Observation of three low wave-lengths is presented as additional evidence for a low origin of the light of the night sky.

X-ray study of the structure of iron-palladium systems shows, according to Dr. R. Hultgren and C. A. Zapffe, that the change from the gamma to the alpha form on cooling takes place in at least two steps: first the atoms rearrange themselves into a body-centred form, then palladium is precipitated out in a face-centred palladium-rich phase.

G. Ehrensvärd and L. G. Sillén discuss further their hypothesis that potential differences at oil-water interfaces are mostly determined by a state of adsorption equilibrium and negligible diffusion; they point out, incidentally, that a change in potential difference may be observed between freshly distilled and old organic liquids, which may be due to molecular re-association.

From the fact that the electrical response in dark-adapted frog's eyes may be greatly reduced without a parallel diminution of the visual purple pigment, Prof. R. Granit, T. Holmberg and M. Zewi conclude that the retinal rods contain a store of visual purple, only the surface part of which appears to be active at a given time.

Vitamin B (thiamin) and riboflavin are found by P. M. West and Prof. P. W. Wilson to be two components synthesized by growing cultures of *Rhizobium trifolii*, and necessary to it, if it is to be continuously transferred in synthetic media.

Prof. G. K. K. Link and Virginia Eggers add one more to the long list of secondary effects of indole-3-acetic acid on plants in reporting that, in concentrations of $1·7 \times 10^{-3}$ to $2·7 \times 10^{-4}$ molar, this substance inhibits, retards or diminishes initiation of adventitious buds in decapitated hypocotyls of flax. These buds are initiated by division of a single epidermal cell without immediately precedent cell enlargement. It is concluded that the native auxin of flax and also indole-3-acetic acid are effective through influencing a cell-division substance or substance complex, which is designated meristin.

An easy conversion of *trans*-dehydro-androsterone into pregnane derivatives is described by Prof. L. Ruzicka and H. F. Meldahl.

By feeding casein hydrolysate, containing heavy hydrogen atoms, for three days to a rat, and determining the proportion of heavy hydrogen atoms in various organs at the end of that period, H. H. Ussing finds indications that about 2·5 per cent of the protein of the muscle and at least ten per cent of the liver protein was newly formed.

Research Items

Cultural Change in the Assam Hills

MR. TARAR CHANDRA DAS, in the course of investigations carried out in 1931, 1932 and 1934, has made a study of certain cultural changes observed among small tribes in the hills surrounding the valley of Manipur, more particularly of the Chirus, included by some in the Naga group, by others among the Old Kuki (*Anthropos*, **32**; 1937). Chiru economic life is based on agriculture, hunting being practised on one occasion only in the year, while fishing, or rather fish-taking, is merely a by-product of irrigation of the paddy fields. Trading is not practised as an occupation, but only as a method of disposing of surplus products, excepting only when betel leaves, obtained by exchange from the Kabuis, are sold as a means of raising money for the hut tax. Two methods of cultivation are practised, *jhumming* in forest land on the slopes of the neighbouring hills, and by irrigation. The latter is possible only on the land at the foot of the hills, and is evidently a recent introduction. This is indicated by various features of Chiru economic, social and religious life. The people have realized the advantages of this form of cultivation, and are gradually migrating towards the edge of the valley. The Chirus are essentially a hill-cultivation people. The size of their villages is determined by the amount of *jhumming* land available, and increase of population, or even internal friction, readily lead to the founding of new villages. The periodical religious rites and ceremonies, which take place on stated occasions in each month throughout the year, are all associated with *jhum* cultivation. They are public festivities in which the whole village participates; but the religious festivals associated with wet cultivation in the irrigated fields are few and are entirely a family matter. The hill-village consists of families, each of which cultivates a patch in the *jhum* land. This land belongs to the village; and though a man has a right to his patch when cleared, it is the usufruct only, enduring until the patch is exhausted and a fresh patch has to be cleared. The wet cultivation fields, on the other hand, are rented from the Government or a landlord; they belong to the family and may be disposed of by sale, mortgage, or otherwise at such a price as the holder may think fit.

Porifera of Krusadai Island

IN a report by Dr. M. Burton, under the title of "Porifera of Krusadai Island" (*Bull. Madras Museum*. Supplement to the Littoral Fauna of Krusadai Island in the Gulf of Manaar. N.S.—Natural History Section, Vol. 1, No. 2, Pt. 4, 1937), many species are included, as explained in an appendix, which were not collected in the Gulf of Manaar. It is to be regretted that the substance of this important appendix, presumably compiled by the Madras Museum, and containing details of localities of occurrence, and colour in life of species, so far as known, was not included in the body of the report. Frequent allusions in the latter to "colour in life", for example, are apparently derived wholly from other sources, and at times in disagreement with that recorded for the material concerned. The scheme of classification is based on the later system of Dendy, with certain modifications; hence, the Hexactinellida being unrepresented, with 76 of the 89 species recorded in the report, placed under the order Tetraxonida. The remaining 13 species are Keratosa; and seven others, as stated in the appendix, are omitted from the report. Under the suborder Astrosclerophora, with 21 species, representing 16 genera, *Ecionema bacillifera* (Carter) is regarded as covering nine other species from the Indo-Pacific region, with a table showing details of their differences. Under the suborder Sigmatosclerophora, which is not defined, 55 species are recorded, representing 26 genera and 3 families. Of the latter, the Desmacidonidæ contains 22 species; the Axinellidæ, though undefined, containing 18 species, and here including the genus *Halichondria*, with one species, *H. glabrata* Keller. The Keratosa appear, through some error, under their two suborders as Dendrokeratida and Dendrokeratina respectively, in place of the Dictyokeratida for the former—signifying, that is to say, the dictyal or net-like character of the skeleton as compared with its dendritic tendency in the other case. But whichever termination of the group name is used, the same in such a case should be retained for both. In the second group, a sponge of doubtful position, without skeleton, is referred to the genus *Hexadella* of Topsent.

Dermatophyte Fungi

THE second fascicle of *Mycopathologia* (**1**, fasc. 2. den Haag: Dr. W. Junk. June 1938), a new journal devoted to fungus parasites of man and the higher animals, includes several papers on skin diseases P. Negroni describes in detail the cultural and microscopic characteristics of *Actinomyces discofoliatus*, which is concerned in human actinomycosis and lachrymal concretions. A new species of *Trichophyton*, named *T. immergens*, had been isolated by S. Milochevitch, who describes its clinical manifestations, its pathogenicity, geographical distribution, and other characters. The disease can spread amongst human beings, and is also contracted from cattle. It usually attacks bare skin, but can also disfigure the beard. The fungus *Oidium albicans* is often associated with superficial diseases of human beings; R. Ciferri, P. Redaelli, and C. Cavallero provide a very detailed summary of the taxonomic position and mycological characters of this species, which should contribute materially to its more correct diagnosis. It is somewhat surprising, but also sufficiently gratifying, that dermatophyte fungi are not very widespread in Great Britain, but the exact results published from time to time in *Mycopathologia* should make the recognition and cure of such attacks as do occur a matter of exact science.

Data of Seismology from the Argentine

A MOST interesting and informative publication has just been received from the Astronomical Observatory of the National University of La Plata in the Argentine Republic. It is the "Resultados Sismometricos" for the years 1932, 1933 and 1934, and was published in 1937 at the observatory. In it are given readings of the station's seismograms, including component, phase, time of arrival, period, amplitude in mm. and

absolute amplitude of ground movement, notes on the phases and notes on the character of the *P* wave and the estimated epicentre. Further, there are short notes on most of the seismograms, a list is given of the number of shocks recorded at the observatory month by month, and there is a geographical index of the epicentres of the shocks. The station is equipped with six instruments: a Mainka 450 kgm. arranged to register east-west movements, a similar instrument to register the north-south movements, a Vicentini 105 kgm., with free period 2·4 sec. and amplification 275 to register east-west movement, a similar instrument to register north-south movement, a Vicentini seismograph of 54 kgm. to register vertical displacement, and a Wiechert 80 kgm. to register vertical displacement. Since in the southern hemisphere there are very few seismological stations at all, and in the southern part of South America south of lat. 30° there are only six such stations in more than half a million square miles, these data will be very valuable.

Air Flow at Surfaces

No. 1803 of Reports and Memoranda of the Aeronautics Research Committee (H.M. Stationery Office. 5*s*. 6*d*.) contains a description of a new method devised by Dr. H. C. H. Townend of the National Physical Laboratory for studying the boundary layer flow of air along solid surfaces. If the surface has the end of an electrode flush with it and an electric spark is made to pass to it from a second electrode a short distance from it, the ions along the path of the spark persist for a short time, and if the air is moving parallel to the surface they are carried along with it. If a second spark passes, it follows the path already ionized which has drifted down stream, and so on for successive sparks. As seen or photographed from the side, the successive spark paths give the amount of drift of ions parallel to the surface in the interval between successive sparks, and therefore the velocity at different distances from the surface. For laminar flow the results found by the new method agree with those given by more elaborate methods, but for turbulent flow rather smaller velocities than the older methods.

Isotopic Lead

In a mass-spectrograph study of the isotopes of twelve samples of common lead, A. O. Nier (*J. Amer. Chem. Soc.*, **60**, 1571; 1938) shows that the relative abundances of the isotopes 204, 206, 207, 208 vary considerably in spite of a nearly constant atomic weight. Those samples which contained relatively more 206 also contained more 207 and 208. A tentative explanation for the variations is found if some of the samples are considered to be 'uncontaminated' lead, and the others to be this with the addition of approximately equal quantities of uranium and thorium leads. As the minerals from which the lead was obtained are essentially free from thorium and uranium, such contamination probably occurred before the mineral was formed. A recent attempt has been made to use the constancy of the atomic weight of ordinary lead (and the alleged isotopic constancy) to prove that this lead cannot be a concentration from granitic or basaltic rocks or their respective magmas, but must have its origin in some deeper source in the earth. The present work invalidates this conclusion; it is not inconsistent with the view that ore lead is related to ordinary igneous rocks, provided that the Th/U ratio in such rocks is taken as 4·0 rather than 1·6 to 2·4, as previously assumed. Reasons are given for supposing that the isotopic variations found are not present in the primeval lead itself, and that they are not due to isotopic separation, although it is emphasized that the theory put forward is tentative. A search for the isotopes 203, 205, 209 and 210 showed that, if these exist at all, they must occur with much lower abundance than was at one time supposed.

Rank Correlation

The problem of comparing two different rankings of the same set of persons is of some importance in psychology, and Prof. C. Spearman's coefficient of rank correlation is well known. An alternative method of measuring rank correlation is proposed by M. G. Kendall (*Biometrika*, **30**, 81; 1938), in terms of a new coefficient for which some advantages are claimed. Both coefficients are easy to calculate, and have distributions which tend to normality for a large population, but the distribution of the new coefficient is surprisingly close to normality even for a small population, and its standard error is known for the case where all possible rankings occur equally frequently. The distribution of the old coefficient is not known, but it appears to present some peculiarities, which will be discussed in a further communication to be published shortly. Finally, it is claimed that the new coefficient has a natural and logical significance.

Distribution of Stars in the Zone −40° to −52°

Dr. J. Jackson has recently published a paper entitled "Distribution of Stars in the Cape Astrographic Zone, −40° to −52°" (*Mon. Not. Roy. Astro. Soc.*, **98**, 7; May 1938) in which there is a very full discussion of the distribution of more than 40,000 stars. This zone has been photographed four times with overlapping series of plates, two series being taken round about 1900 with relatively short exposures, the fourth series being taken in 1923–28 for the determination of proper motions in conjunction with the most suitable of the earlier plates. There has been close co-operation with Harvard Observatory in the determination of spectral types, and the spectra of 38,713 stars in the zone were classified by Miss Cannon. Fifteen tables are given in the paper, and these deal with a multitude of subjects, amongst which may be mentioned the number of stars of each spectral type arranged according to galactic latitude and apparent photographic magnitude, separation of stars into dwarfs and giants by means of counts of stars according to magnitude, mean colour indices according to apparent photographic magnitude, percentage of stars in different ranges of proper motions, etc. Table XV shows the density distribution according to spectral type, and it has been computed from assumed absolute photographic magnitudes for stars in the main sequence. Although the table has been extended as far as type Go, the results have little meaning at this stage because many of the stars included do not belong to the main sequence. This table is very interesting, showing the great difference in the number of stars of different spectral type. There is a clear falling off of density in the groups of apparently bright stars, and it is suggested that the effect may not be real but may be due to the presence of distant giant stars in these groups.

Grain Structure of Sand Dunes and its Relation to their Water Content

By Major R. A. Bagnold, Imperial College of Science and Technology

THE stratification of wind-accumulated sand beds is well-known, and the evidence of it can often be seen on the vertical faces of sand-pits. Beadnell[1] has shown that the laminar structure of fresh non-cohesive dune sand can also be observed, if the dry dune is soaked with water to allow a vertical face to be exposed without collapse. The strata he thus exposed dipped at the angle of repose of sand, which experiments show to lie between 30½° and 35½° to the horizontal[2]. In this case the succeeding layers have been formed by sand which, having been driven over the surface of the dune, has come to rest temporarily sheltered on the upper part of the slope, and has accumulated there, increasing the angle of the slope until shear occurs. An avalanche then takes place down the slope from top to bottom (Fig. 1). Fresh sand deposits formed in this way are characterized by their loose packing and by their extreme softness. I have called[3] such a mode of deposition 'encroachment'.

Another type of deposition occurs on a smooth sand surface over which sand is being driven by the wind, when, for various reasons previously discussed[3], more grains come to rest on the surface than are picked up from it. In this case, which I have called 'accretion', the packing of the grains is very close and orderly, and the structure is peculiarly firm under normally applied pressure. The layers here run parallel to the surface exposed to the wind. (The accretion structure very probably corresponds to that of 'wind-packed' snow.) If a dune has advanced and grown bigger at the same time, both kinds of structure, encroachment and accretion, are present (Fig. 2). This accounts for the alternate patches of firm and yielding sand found on desert dune surfaces.

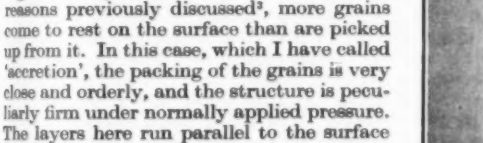

Fig. 1.

Fig. 2.

I have recently investigated the structure of a series of desert dunes, during an expedition carried out with the aid of a Government grant allotted to me by the Royal Society. When a small quantity of water—half a pint—is allowed to soak gently into a given spot on a dune surface, and the dry sand is scooped away from one side of the wetted area by hand, it is found that the water has travelled farther and faster through some of the layers than through

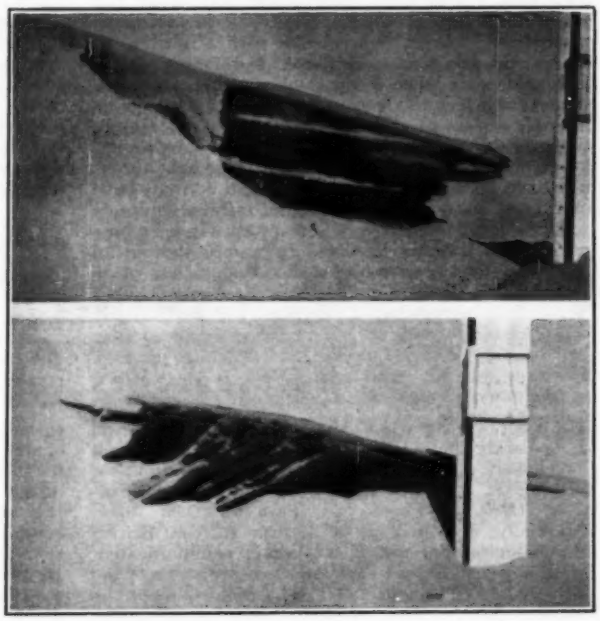

Fig. 3.

others. Parallel wetted layers 1–4 mm. thick are left sticking out sideways like wafers between voids a centimetre or more in thickness from which the dry sand has fallen away.

Fig. 3 shows photographs of the structures thus exhibited, taken on the same dune surface and at spots a few feet from one another on either side of a boundary, superficially invisible, between very firm and very soft sand. The upper photograph shows a firm accretion deposit through which a new top surface has been cut by the wind. In the lower photograph a typical soft encroachment deposit has been laid bare by the same denudation, and afterwards an accretion deposit has begun to grow on the top of it. (In both cases the sand where not wetted appeared merely as a loose structureless mass, and even when wetted showed practically no structure when afterwards cleft down with a knife.)

The differential rate of travel of water through sand seems to be due to variations in the effect of surface tension caused by differences in the proportion of fine grains present in succeeding layers. It can be verified experimentally that water seeps faster through sand containing fine grains than through sand which does not.

In the case of the accretion deposit (Fig. 3), I have shown experimentally[4] that the proportion of fine grains in such a deposit is controlled mainly by the composition of the source from which the sand comes. A change of wind direction may therefore alter the fine-grain composition of the deposit, even assuming it to be growing steadily the while. In the same paper it was pointed out that the process of denudation tends to concentrate on the surface both extremely coarse and extremely fine grades. There are therefore two possible causes of the variation in texture.

The cause of the laminar structure of encroachment deposits is more interesting. Since the grains reach their final resting place after avalanching down the slope, the structure appears not to be due to direct wind action. From experiments with a mixture of coarse and fine sands, each dyed a different colour, it appears that when a dry sand avalanches down a slope the finer grains become concentrated along the internal surface of shear. When afterwards wetted, the mixture shows just the same structure as the lower photograph in Fig. 3. This phenomenon does not seem to be generally known, and it may have useful applications in experimental soil mechanics.

That desert dunes are able to retain for very long periods the moisture received from rare showers of rain has long been recognized. But it has often puzzled me why such patches of moisture should be found beneath the sand surface in some places but not in others nearby. The explanation now seems to lie in the different structure of the two kinds of sand structure. When rain falls on an exposed encroachment deposit, the water seeps rapidly downwards along the old shear planes into depths at which it is immune from temperature changes and consequent evaporation. When, on the other hand, it falls on a firm accretion structure, it spreads out laterally along the surface layers of finer grain composition, and is hindered from sinking by the intervening layers of sand which are lacking in fine grains. It therefore remains near the surface and is soon lost by evaporation.

In all cases where I found a moist zone beneath the dry surface, and in most cases where blades of dead grass were still visible on the dunes, the sand when wetted showed the steeply dipping structure of the encroachment formation. This is in accord, too, with my experience when motoring over dunes in very arid country, that areas containing occasional dead vegetation are to be avoided owing to their probable softness.

[1] Beadnell, H. J. L., *Geog. J.*, **35**, 387 (1910).
[2] Jenkin, C. F., *Proc. Inst. Civ. Eng.*, **234**, 112 (1933).
[3] Bagnold, R. A., *Geog. J.*, **89**, 432 (1937).
[4] Bagnold, R. A., *Proc. Roy. Soc.*, A, **163**, 250–264 (1937).

Researches in Hypnosis

IN a noteworthy article, the first to appear from the recently founded Institute of Experimental Psychology at Oxford, Dr. William Brown discusses "Hypnosis, Suggestibility and Progressive Relaxation" (*Brit. J. Psych.*, **28**, Part 4: April 1938). Originally delivered as a lecture to the British Psychological Society, it was again communicated, in an abridged form, to the Psychology Section of the British Association in 1937. The importance of its content justified this second communication at the Nottingham meeting, when many members of other sections had the opportunity of hearing and discussing it. Dr. Brown has been well advised to have the lecture printed.

Beginning with a brief outline of its history and development from the time of Mesmer, the author even more briefly expounds his own theory of hypnotism and a technique for inducing hypnosis, which may or may not include muscular relaxation. In his therapeutic practice, however, relaxation is always induced, beginning with the small muscles of the extremities, extending to the greater muscle groups of limbs and torso, and ending with all the lesser muscles involved in speech and vision. This process not only secures a calm and tranquil state of body, but also tends to extinguish both inner speech and visual imagery, which might support conscious activity and keep the mind alert. As Jacobson has experimentally shown, progressive relaxation is of the highest importance in many pathological conditions, and of itself may effect their alleviation and even removal. Combined with hypnosis, it secures a passive and receptive state of mind, during which curative suggestions may be given to the patient with every expectation of success. The physician also pays attention to the respiration of his patient, which is normally an autonomic function, in order to induce a slow, regular and rhythmical movement of diaphragm and intracostal muscles, which makes for still greater mental passivity. Though the author does not refer to him, Heyer has pointed out that this, the only autonomic process which is also under conscious control, enables us indirectly to influence the functioning of other autonomic processes. Dr. Brown, however, lays stress upon another way of securing control over the autonomic nervous system, namely, by means of the forming of conditioned reflexes. Hudgins, using Pavlov's method, has shown experimentally that the pupillar reflex can be 'conditioned' to the sound of the word 'contract' when, just after pronouncing it, a bright light is flashed upon the eye. In time, the pupil comes to contract when the subject of the experiment pronounces the word 'contract' himself, or even thinks it, thus enlarging the scope of his volitional control, even if only indirectly. The psychotherapeutic value of this process of conditioning would seem to be evident; since, as Dr. Brown points out, a word, or thought, may be associated with the operation of a drug, and in time come to act as a substitute for it.

What is, however, of greatest interest in this paper is the account given of the experiments upon the patellar reflex, carried out at the Oxford Institute by Dr. Brown himself, by which it was shown that normal sleep and the hypnotic condition can be distinguished by their several effects upon the knee-jerk. The subject was seated in a chair; and every ten seconds a smart tap was given on the patellar tendon by an electrically controlled hammer. The excursion of the reflex movement was recorded upon the smoked paper of a kymograph by a lever which was connected by a thread passing over a pulley to the subject's foot, thus securing a continuous record.

The method followed was to cause the subject to fixate his eyes upon a bright light, and to secure relaxation by suggestions of drowsiness, sleep and rhythmical breathing. The subject becomes deeply relaxed; and, though not asleep, his knee-jerks are abolished. But, when suggestions of a hypnotic kind (for example, that he cannot open his eyes) are given, the reflex manifests itself again.

A similar criterion of the distinction between sleep and hypnosis is found in the so-called psycho-galvanic (or skin constrictor) reflex. The more relaxed the subject becomes, the more the body resistance rises; the less there is of 'alertness'. But, when hypnotic suggestions are given, the resistance falls. It would seem that hypnosis is a state of peculiar, though restricted, vigilance; whereas lethargy is a blend of hypnosis and drowsiness, or sleep.

These and like experiments show the possibility, and indicate the importance, of extending laboratory methods to the investigation of 'abnormal' and pathological states.

The Arctic Fauna

GREAT interest in arctic exploration during the last few decades has resulted in a large number of publications on its fauna, mostly descriptive in character and restricted either to certain areas or to groups of animals. The only comprehensive work on the subject is the well-known "Fauna Arctica," written by numerous contributors under the editorship of Roemer and Schaudinn, which contains extensive lists of animals, mostly devoid of any general information and useful mainly for the statistics of the fauna. The questions of the origin and evolution of the arctic fauna have been attacked by some zoogeographers; but their comprehensive treatment from a modern point of view was lacking. This gap is now filled by Prof. N. J. Kusnezov, who has succeeded in less than a hundred pages in presenting a remarkably concise and clear survey of the whole problem.*

The term 'arctic', as understood by the author, comprises the territories occupied by the tundra proper and by the northernmost marginal belt of the forest zone with its scattered, stunted trees. An up-to-date list of the number of species in each group of animals is given, the total being about 5,500 species. The actual number of arctic species is estimated as at least three times as many. The number of vertebrates, except birds, is too small to permit reliable zoogeographical conclusions, while birds, although numerous (270 species), are represented almost exclusively by non-resident species, which spend in the arctic only a very short breeding period. Most of the invertebrates are still insufficiently studied; but insects are represented by an unexpectedly large number of species, particularly of Diptera, Hymenoptera, Coleoptera and Lepidoptera.

The existence of the arctic fauna under the peculiar environmental conditions of high latitudes undoubtedly suggests a long period of adaptation. Unfortunately, the physiological aspect of this adaptation remains unstudied and is probably not the same in different groups. One point, however, appears certain, namely, that the present composition of the arctic fauna is determined not so much by the thermal conditions of the arctic, as by nutritional interrelations of organisms, that is, primarily by plant life, which is mainly dependent on the peculiar seasonal distribution of daylight.

As regards the taxonomic composition of the arctic fauna, it proves to be most heterogeneous, including representatives of both primitive and highly specialized groups, while there is no group that may be regarded as specially adapted to arctic conditions. This complexity of arctic fauna suggests a very chequered history. From a zoogeographer's point of view, this history can be best made intelligible by accepting the theory of longitudinal displacements of climatic zones (Koeppen-Wegener), causing corresponding migrations of animal population.

Among the various historical elements of the arctic fauna, an important place belongs to the 'euarctics', as the author calls endemic species now living only under arctic conditions, although they have no apparent ecological or physiological adaptations. The primary origin of the euarctics is obscure, but in Lepidoptera, for example, a taxonomic analysis of euarctic forms points clearly to their origin from the Tertiary fauna of the Angaran continent. Moreover, it is highly probable that many of the euarctics should be regarded not as postglacial immigrants into the arctic zone, but as relics of a preglacial fauna. This assumption is based on quite legitimate doubts of the severity of conditions during glaciation (which is usually taken for granted), and on the existence of numerous plants and animals under most intense arctic conditions, for example, in Greenland and on arctic islands.

The Quaternary glaciations resulted in a southward migration of most arctic organisms which found temporary refuges on the edges of glaciated areas. This was followed by return migrations during the inter-glacial periods, and these repeated movements led to the great complexity in the composition of the present Arctic population, in which, apart from the Angaran elements, those derived from 'refuge areas' in western Europe, in the centre and extreme east of Asia, and in the north-west of North America, can be distinguished.

Incidentally, the analysis of the Arctic fauna throws some light on the similar great heterogeneity of the more southern faunas, namely, the palæarctic and the nearctic, and the author insists very emphatically that the time has come when the current conception of rigidly defined zoogeographical regions should be drastically revised on the basis of modern ecological and geological knowledge and theories.

The work of Prof. Kusnezov deserves close study not only by those specially interested in the arctic, but also by biologists in general, since it represents a courageous attempt to discuss a wide biogeographical problem from a thoroughly modern point of view and with a healthy critical attitude towards generalizations that are generally accepted merely because they are often repeated.

A good bibliography on the arctic fauna (and partly flora) comprising twelve pages concludes this interesting paper.

B. P. UVAROV.

* Kusnezov, N. J. "The Arctic Fauna of Eurasia and its Origin". (In Russian with an English summary.) *Trav. Inst. Zool. Acad. Sci. U.R.S.S.*, 5, Part 1, 1938; 85 pp.

Vegetable Poisons of Africa

DR. G. CUFODONTIS has reviewed these numerous vegetable poisons of which the native peoples of Africa have made use from time immemorial in war, hunting, fishing and the destruction of fierce and noxious animals (*Scientia*, Ser. 3, 32, 1–5; 1938). Though the use of these poisons by the natives has long been recorded by travellers, owing to lack of botanical and chemical knowledge information is often defective. Native methods of extraction are often not only complicated, but also surrounded by mystery and magical ritual, making observation a matter of difficulty.

Strophanthus, a genus widely spread over the whole of tropical Africa, is the principal source of the most powerful African poisons. Its use was recorded so long ago as 1865 by Livingstone on the Zambezi, though the actual plant used was not identified until long after. As an arrow-poison it is fatal to man and most animals, only such large pachyderms as the elephant and hippopotamus being resistant. In West Africa *S. hispidus* is used, while in Senegal and Guinea its effects have been known to Europeans by fatal experience since the fifteenth century.

The genus *Acocanthera*, of which half a dozen species are found in different parts of tropical Africa, produces a poison which, acting on the nervous system and by vaso-constriction, is even more powerful than strophanthin, an arrow wound causing death in about one hour. *A. ouabaio*, confined to Somaliland, and *A. Schimperi* in Abyssinia, Somaliland, Kenya and Tanganyika, produce a powerful poison, effective, it is said, even in pachyderms which resist strophanthin. The *adeniums*, confined with one exception to Somaliland and the adjacent regions including Socotra, are strongly toxic. They produce a latex which the Somalis use, not for their arrows, but for poisoning bait to kill destructive or dangerous animals near the villages. The active principle is a toxic glucoside which has not yet been analysed. In South Africa a strong arrow poison is extracted from *Toxicophlæa Thunbergii* and also from the bulbs of one of the Amaryllidæ *Buphana disticha*, which contains narcissin, hemanthin and a strongly toxic amorphous alkaloid, buphanin. A large family, very rich in poisons, is the Euphorbiaceæ, which contain five distinct groups of poisons. In Africa the use of poisons extracted from members of this family is confined to the Bushman, Bongos and certain Arabs, while on the east coast at Zanzibar one variety is used in fishing. Few of the leguminous plants are used, and most of these for fishing. It is remarkable that the *Strychnos* group, which in other continents produces such terrible toxic agents as curare in America and the upas poison of Indonesia, in Africa holds a very subordinate position.

Science News a Century Ago

Engineering Education at University College, London

IN the autumn of 1838, courses in civil engineering were arranged at both King's College, and University College, London. An advertisement in the *Athenæum* for September 1, 1838, said "Courses of lectures in aid of the system of instruction pursued in the offices of Civil Engineers, will be given at University College in the course of the ensuing Session.

"Every Saturday evening, from 7 to 9, Mr. De Morgan, Professor of Mathematics, will give Lectures and Praxes, the principal object of which will be to teach the application of Arithmetic to the results of Algebra and Geometry. Mr. Sylvester, Professor of Natural Philosophy, will deliver an Elementary Course principally on the Mechanics of Solid Bodies, and the Doctrine of Heat, and their application to the Steam-engine. The Lectures of Professor Sylvester will be given every Wednesday evening from 8 to 10.

"By attending a Course, or Courses of the Practical Chemistry of Professor Graham, on Monday, Wednesday and Friday from 4 to 5, the Civil Engineer will be exercised in the manipulation of testing and analysing, especially as regards mineral substances used in the arts."

Lyell and the British Association

ON September 1, 1838, Lyell wrote from his father's house at Kinnordy, Forfarshire, to his father-in-law, Leonard Horner, giving an account of his journey to Newcastle for the meeting of the British Association. He had been through Suffolk and Norfolk geologising, and at Norwich had "avoided all but collectors". The journey northward was made in one steamer from Yarmouth to Hull and then by another from Hull to North Shields. From Shields he made a long excursion to Tynemouth along the shore, went by gig to Cullercoats "where the ninety-fathom dike is laid open in the cliffs, the magnesium limestone on one side and the coal on the other", visited a railway cutting and crossed the Tyne to the Marston Rocks, "where there are lofty perpendicular cliffs of magnesium limestone, and small isolated rocks or needles of the same in the sea". At Newcastle Murchison told him he would be president of the geological section. "All that I saw of the government of the Association," he wrote, "gave me a good idea of the spirit, but no wish to consume my time in taking part in it, to which I am invited, I hear, by being put on the council. Sedgwick was so eloquent; his lecture to 3,000 people on the sea-shore made a great impression."

A Uniform System for Railways

IN 1838 Nicolas Wood (1793 ?–1865) published the third and last edition of his "Practical Treatise on Rail-roads and Interior Communication in General, etc." In a review of this edition, *The Civil Engineer and Architects' Journal* in its September number said: "It is now generally admitted that Railways must shortly become the great highways of the kingdom; and it consequently becomes an object of national importance to consider the best modes both of constructing and working them. It appears to us highly desirable that they should all be governed by one law, and all their regulations should be uniform. . . . Regretting, as we do, that the opportunity should have been lost of carrying on the railway system from the first on a uniform and consistent plan, we think that much might yet be accomplished towards this very desirable object. For this end we would recommend as a highly desirable measure, the immediate formation of what might be termed a Railway Congress consisting of one Director and the Engineer of each line. . . . Their decision should be binding on all the companies, and when necessary, they might recommend to Parliament bills for the regulation of railways, which from such a body would come supported by the high authority of extensive and practical experience."

Societies and Academies

Paris*

Academy of Sciences, June 27 (*C.R.*, **206**, 1933–2038).

PIERRE DUBOIS and PAUL BRETON: Study of the ammonium vanadates.

JEAN CALVET, PIERRE JACQUET and ANDRÉ GUINIER: The hardening by ageing of an aluminium-copper alloy.

DENIS DUVEEN: An attempt at a partial asymmetric synthesis.

LÉON PALFRAY: Catalytic hydrogenation in the naphthalene series.

JEAN CUVILLIER: Contribution to the study of the Nummulitic of Hadhramaout (Southern Arabia).

RAOUL COMBES: The action of the medium on the nitrogen nutrition of the flower.

MLLE. MARIE CELAN: The chondriosomes, plasts and nuclei in the course of evolution of the cystocarp in *Halopithys pinastroides*.

THÉODORE SOLACOLU, DÉMETRE CONSTANTINESCO and MME. MARGUERITE CONSTANTINESCO: The anatomical and cytological study of the modification provoked by organo-formative substances on the decapitated stems of *Vicia Faba*.

MME. LUCIENNE LAVIER-GEORGE: Variations in the organization of the leaflets of *Laburnum vulgare*.

CHARLES CHABROLIN: The germination of the seeds of *Orobanche speciosa*.

ANDRÉ PAILLOT: The process of moulting in the middle intestine of the caterpillars of the silkworm.

PIERRE CARRÈRE: Researches on the evolutionary cycle of the trematodes of fishes.

ALBERT CHAUCHARD, MME. BERTHE CHAUCHARD and PAUL CHAUCHARD: Contribution to the quantitative study of the variations of excitability of the respiratory centre.

HENRY BULLIARD and ISRAËL GRUNDLAND: Experiments relating to the behaviour of the lipoproteic complex.

PIERRE GIRARD and NÉDA MARINESCO: Ultrasound centrifugal machine.

BASILE LUYET and GRÉGOIRE THOENNES: Demonstration of the isotropic properties of cellular masses vitrified at the temperature of liquid air.

CHARLES DHÉRÉ and VERO CASTELLI: The properties of the photoluminescence of synthetic flavin.

MLLE. BERTHE BIECHELER: The cinetid of the Peridineans.

ALBERT PEYRON, GUY POUMEAU-DELILLE and PIERRE MERCIER: The origin and significance of the different varieties of histiocytes observed in inflammatory lesions and in the course of immunity reactions.

*Continued from p. 367.

Moscow

Academy of Sciences (*C.R.*, **19**, No. 3; 1938).

L. PONTRYAGIN: Classification of continuous transformations of a complex into a sphere (1).

A. GROŠEV: A theorem of linear systems.

P. BAŽULIN: Absorption of ultra waves in electrolytes.

I. I. KORNILOV: Kinetics of the formation of Mg_3Cd and $MgCd_3$ from solid solutions of Mg—Cd alloys.

A. A. ARSENYEV: Age of the Vitim basalts.

N. KOGAN: Stratigraphy of Tertiary formations in the south-western part of Soviet Sakhalin.

I. V. LUCHIZKY: Ultra-basic rocks of Eastern Transbaicalia.

V. K. MONICH: Average chemical composition of the Cambrian basaltic lavas of West Siberia.

P. J. SCHMIDT and G. P. PLATONOV: Seasonal character of the response of fishes to low temperature.

K. A. MIKHAILOVA: Chromosome morphology of cotton.

H. F. KUSHNER: Blood compositions of yaks, cattle and their hybrids, in connexion with the heterosis of hybrids.

A. SCHMUCK: Chemical nature of substances inducing polyploidy in plants.

M. NAVASHIN: Influence of acenaphthene on the division of cells and nuclei.

DONTCHO KOSTOFF: Irregularities in the mitosis and polyploidy induced by colchicine and acenaphthene.

A. I. ZUITIN: New data on the chromosome number in yak (*Poephagus grunmens* L.).

V. L. RISCHKOV and E. P. GROMYKO: A new method for the purification of the tobacco mosaic virus.

K. S. SOUKOV and A. M. VOVK: Mosaic disease of oats.

N. ARKHANGELSKAYA: New methods for studying the brown spot disease in potato.

L. G. DOBROUNOFF: Critical periods in the mineral nutrition of plants.

M. CH. ČAJLACHJAN and L. P. ŽDANOVA: Role of growth hormones in form-building processes. (2) Vernalization and formation of growth hormones.

Rome

National Academy of the Lincei (*Atti*, **26**, 433–472; 1937).

G. NEBBIA: Lines of the total quantities of motion in permanent liquid currents which vary gradually.

F. TRICOMI: Theory of the elastic arc with a circular directrix (2).

L. GIALANELLA: New researches on the solar group of stars (1).

P. SCONZO: Effect of the displacement of continents on the duration of the earth's rotation (1).

A. BARONI: Action of selenium sulphur protochloride and of sulphur selenium protochloride on ethyl mercaptan and on ethyl selenium mercaptan. (2) Selenoglycerin[illegible].

Atti, **27**, 3–36; 1938.

O. SCARPA: Equations for the thermodynamic calculation of the electromotive forces of gas cells.

O. SCARPA and C. ROSSI: Volta effect in solid metallic alloys (1).

T. BOGGIO: Curvature of a surface and of a variety.

U. SALINI: Assemblage of quadrics defined in one point of a surface.

G. GARCÍA: General equations of the restricted relativity dynamics.

G. LAMPARIELLO: Compounding of motions according to Poincaré.

A. CORRADETTI: A new classification of *Haemosporidiidea* based on the existence of a schizogonic cycle of the plasmodes in the cells of tissues.

A. MISSIROLI: Development of malarial parasites.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT SUPERINTENDENT in the Central Workshops Division, Public Works Department, Irrigation Branch of the Government of the Punjab—High Commissioner for India, General Department, India House, Aldwych, W.C.2 (August 31).

ASSISTANT LECTURER IN ESTATE MANAGEMENT at the Royal Agricultural College, Cirencester—The Principal (September 1).

JUNIOR SCIENTIFIC OFFICERS at the Road Research Laboratory, Harmondsworth, West Drayton—Establishment Officer (J.38/10), Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (September 13).

SUPERINTENDENT OF THE MARINE DIVISION of the Meteorological Office—Under-Secretary of State (S.2.A.), Air Ministry, Adastral House, Kingsway, W.C.2 (September 30).

OFFICERS-IN-CHARGE (3 posts) of Electrical, Physical and Metrological Sections of the Australian National Standards Laboratory—Official Secretary, Australia House, Strand, W.C.2 (September 30).

LECTURER IN MATHEMATICS AND PHYSICS at the Natal University College, Durban—The Registrar of the College, P.O. Box 375, Pietermaritzburg (November 1).

ENGINEER for the Posts and Telegraphs Department of Malaya—Crown Agents for the Colonies (M.6330), 4 Millbank, S.W.1.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Association of Special Libraries and Information Bureaux. Aslib Book-List. Vol. 3, No. 3, July. Pp. 69–104. (London: Association of Special Libraries and Information Bureaux.) Free to members; subscription for non-members, 10*s.* 6*d.* per annum. [38

The Board of Greenkeeping Research. Report for 1937 and a General Account of the Work in Progress. Pp. 76. (Bingley: St. Ives Research Station.) 2*s.* [58

Technical Publications of the International Tin Research and Development Council. Series A, No. 77: The Constitution of the Alloys of Tin with Bismuth. By A. C. Davidson. Pp. 16+4 plates. (London: International Tin Research and Development Council.) Free. [58

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. Vol. 237, No. 778: Application of the Phase Integral Method to the Analysis of the Diffraction and Refraction of Wireless Waves round the Earth. By T. L. Eckersley and G. Millington. Pp. 273–310. 5*s.* Vol. 237, No. 779: Tides in Oceans bounded by Meridians. 3: Ocean bounded by complete Meridian; Semidiurnal Tides. By A. T. Doodson. Pp. 311–374. 8*s.* Vol. 237, No. 780: On Bipartitional Functions. By P. V. Sukhatme. Pp. 375–410. 4*s.* (London: Cambridge University Press.) [98

Department of Scientific and Industrial Research. Report by the Director of Fuel Research on a Demonstration of the Freeman Assay for Coal and Carbonaceous Materials; Demonstration witnessed May 1938. Pp. iv+5. (London: H.M. Stationery Office.) 3*d.* net. [98

Experimental Researches and Reports published by Department of Glass Technology, The University, Sheffield. Vol. 20, 1937. Pp. iv+300+30 plates. (Sheffield: The University.) 7*s.* 6*d.* [98

Nineteenth Annual Report of the Ministry of Health, 1937–38. (Cmd. 5801.) Pp. xi+318. (London: H.M. Stationery Office.) 5*s.* net. [118

Wild Life—and Rare in National Parks and Paradises round the World (Wild-flowers, Trees, Birds, Animals, Scenery). By Millicent H. Morrison. Pp. 42. (London: Green Cross Society.) 1*s.* [118

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1937. Pp. 294+15 plates. (Bristol: The University.) [158

British Association for the Advancement of Science: Gray-Milne Trust. Tables for converting Geographic into Geocentric Angular Distances. By Dr. K. E. Bullen. Pp. vii+19. (London: British Association for the Advancement of Science.) [158

Other Countries

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1937. Pp. 18+2 plates. (Pretoria: Government Printer.) [38

Bulletin of the American Meteorological Society. Vol. 19, No. 5: Some American Papers and Notes on Climatic Variations. Report of the American Committee of the International Commission of Climatic Variations, to the International Geographical Congress, Amsterdam, Holland, July 1938. Pp. 161–224. (Milton, Mass.: American Meteorological Society.) 50 cents. [38

Union of South Africa: Department of Agriculture. The Onderstepoort Library Index. Pp. 153. (Pretoria: Government Printer.) 2*s.* 6*d.* [38

U.S. Department of Agriculture. Technical Bulletin No. 609: Chemical and Physical Properties of Certain Soils developed from Granitic Materials in New England and the Piedmont, and of their Colloids. By Irvin C. Brown and Horace G. Byers. Pp. 56. (Washington, D.C.: Government Printing Office.) 10 cents. [38

New York Zoological Society. Report of the Director of the Aquarium. Pp. 20. (New York: New York Zoological Society.) [38

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 164: On the Standing Wave in a Water Column measured by a Broca-Tube. By Yûtaro Nisimura and Yutaka Kohasi. Pp. 245–272. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 45 sen. [58

Hamburger Sternwarte in Bergedorf. Zweites Bergedorfer Sternverzeichnis 1930·0. 2 Nachtrag enthaltend Eigenbewegungen von 251 Sternen sowie Zusätze und Berichtigungen zum Sternverzeichnis. Herausgegeben von Dr. Richard Storr. Pp. 91–98. (Bergedorf: Hamburger Sternwarte.) [58

The Rockefeller Foundation. Annual Report, 1937. Pp. ix+502. (New York: The Rockefeller Foundation.) [98

Publications of the Observatory of the University of Michigan. Vol. 7, No. 4: Spectrophotometric Determination of Stellar Temperatures; the Color Temperature of α Lyræ. By Robley C. Williams. Pp. 93–125+1 plate. (Ann Arbor: University of Michigan.) [98

Smithsonian Miscellaneous Collections. Vol. 97, No. 5: Three Pictographic Autobiographies of Sitting Bull. By M. W. Stirling. (Publication 3482.) Pp. ii+57+46 plates. (Washington, D.C.: Smithsonian Institution.) [98

U.S. Department of Agriculture. Technical Bulletin No. 616: The Reproductive Cycle of the Coyote. By G. W. D. Hamlett. Pp. 12+2 plates. (Washington, D.C.: Government Printing Office.) 10 cents. [98

University of Missouri Studies: a Quarterly of Research. Vol. 13, No. 2: Distance Geometries; a Study of the Development of Abstract Metrics. By Prof. Leonard M. Blumenthal. Pp. iv+145. (Columbia, Mo.: University of Missouri.) 1.25 dollars. [98

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 117: The Regional and Seasonal Incidence of Grasshopper Plagues in Australia. By Dr. K. H. L. Key. Pp. 87+3 maps. Pamphlet No. 78: A Copper Deficiency in Plants at Robe, South Australia. 1: Preliminary Investigations on the Effect of Copper and other Elements on the Growth of Plants in a "Coasty" Calcareous Sand at Robe, South Australia, by D. S. Riceman and C. M. Donald; 2: The Occurrence of "Reclamation Disease" in cereals in South Australia, by C. S. Piper. Pp. 28+6 plates. Pamphlet No. 79: A Report on the Conditions of Animal Production in Australia. By Dr. John Hammond. Pp. 24. (Melbourne: Government Printer.) [98

Indian Forest Records (New Series). Utilization, Vol. 1, No. 6: Ascu—a Wood Preservative. By the Forest Research Institute, Dehra Dun. Pp. iv+143–187+5 plates. 14 annas; 1*s.* 6*d.* Entomology, Vol. 3, No. 10: Immature Stages of Indian Lepidoptera (1) Lymantriidæ. By J. C. M. Gardner. Pp. 187–212+4 plates. 1 rupee; 1*s.* 9*d.* (Delhi: Manager of Publications.) [98

Bulletin of the Madras Government Museum. New Series, Natural History Section, Vol. 4, No. 2: Supplement to the Flowering Plants of Madras City and its immediate Neighbourhood. By E. Barnes. Pp. iii+46+7 plates. (Madras: Government Press.) 1.10 rupees. [98

Yale University Publications in Anthropology. No. 18: The Agricultural and Hunting Methods of the Navaho Indians. By W. W. Hill. Pp. 194+4 plates. (New Haven, Conn.; Yale University Press; London: Oxford University Press.) 11*s.* 6*d.* net. [98

City of Durban: Durban Museum and Art Gallery. Annual Report for Municipal Year 1936–1937. Pp. 12+4 plates. (Durban: Museum and Art Gallery.) [98

Newfoundland Government: Department of Natural Resources. Research Bulletin No. 4: Some Fishes of Newfoundland Waters (with Notes on the Distribution of Eggs and Larvæ). By Nancy Frost. Pp. 16+8 plates. 20 cents. Research Bulletin No. 5: The Genus Ceratium and its Use as an Indicator of Hydrographic Conditions in Newfoundland Waters. By Nancy Frost; with an Appendix on Hydrographic Conditions (reprinted from Annual Report 1936–37), by Anna M. Wilson. Pp. 15+9 plates. 20 cents. (St. John's, Newfoundland: Department of Public Works.) [108

University of California Publications in American Archæology and Ethnology. Vol. 35, No. 6: The Kepel Fish Dam. By T. T. Waterman and A. L. Kroeber. Pp. iii+49–80. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 1*s.* 3*d.* net. [100

Malta. Report on the Work of the Museum Department for 1937–38. Pp. xx. (Valletta: Valletta Museum.) [118

Trinidad and Tobago: Forest Department. Council Paper No. 20 of 1938: Administration Report of the Conservator of Forests for the Year 1937. Pp. 16+1 map. (Trinidad and Tobago: Government Printer.) 12 cents. [158

Journal of the Indian Institute of Science. Vol. 21 A, Part 1: Activation and Clarifying Properties of Fuller's Earth. Part 4: Equilibrium in the Ionic Exchanges in Fuller's Earth. By B. S. Kulkarni and S. K. K. Jatkar. Pp. 8. 12 annas. Vol. 21 A, Part 2: A Preliminary Study of the Clarification of Extracts for Estimating Sugars in Plant Materials. By A. V. Varadaraja Iyengar. Pp. 9–14. 10 annas. Vol. 21 A, Part 3: Refractive Dispersion of Oils and Fats. Part 1: Dispersion of Ghee and Vegetable Oils. By V. T. Athavale and S. K. K. Jatkar. Pp. 15–26. 1 rupee. Vol. 21 A, Part 4: Researches on Utilization of Cane Molasses, Part 1: Dissolution of Bone by Fermentation of Cane Molasses. By T. R. Bhaskaran, S. C. Pillai and V. Subrahmanyan. Pp. 27–40. 1.2 rupees. Vol. 21 A, Part 5: Constitution of the so-called Dithiourazole of Martin Freund; Ring Closure of Hydrazo-Dithio-Dicarbonamide and its Mono- and Di-Substituted Derivatives; Part 7: Action of Heat; Part 8: Action of Sodium Hydroxide (Contd.); Part 9: Action of Hydrochloric Acid (Contd.); Part 10: Action of Acetic Anhydride (Contd.), by P. C. Guha and D. R. Mehta; Part 11: Isomeric Changes of some Triazoles and Thiobiazoles, by P. C. Guha and S. L. Jannah. Pp. 41–64. 1.12 rupees. Vol. 21 A, Part 6: Coupling of Methone with Tetrazonium Compounds. By Balkrishna H. Iyer. Pp. 65–76. 1 rupee. Vol. 21 A, Part 7: System Sulphuric Acid-Ethers, Part 2: System Sulphuric Acid Propyl Ether. By S. K. Kulkarni Jatkar and N. G. Gajendragad. Pp. 77–88. 1 rupee. (Bangalore: Indian Institute of Science.) [158